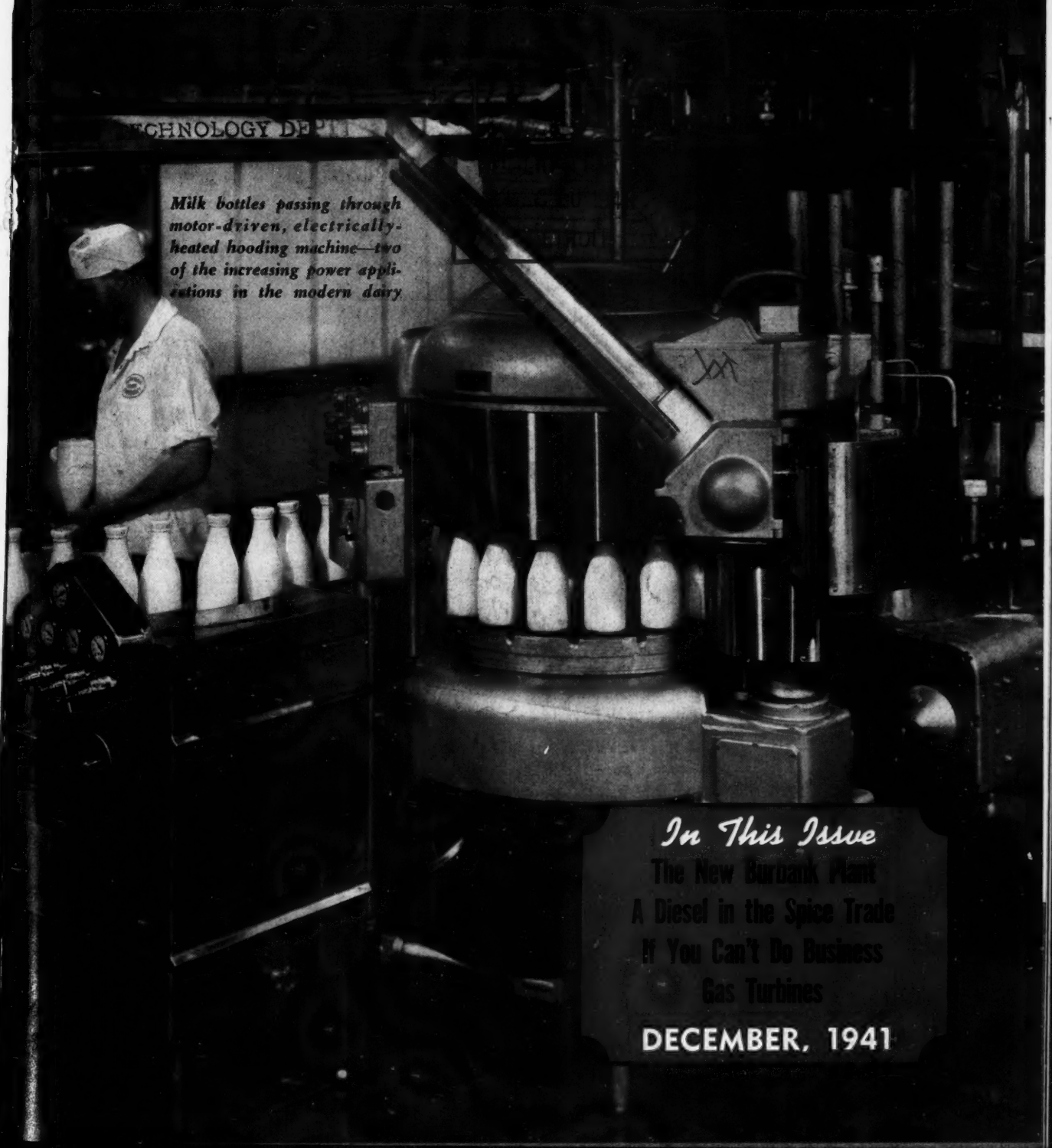
POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



Milk bottles passing through motor-driven, electrically-heated hooding machine—two of the increasing power applications in the modern dairy

In This Issue

The New Burbank Plant

A Diesel in the Spice Trade

If You Can't Do Business

Gas Turbines

DECEMBER, 1941

ELLIOTT

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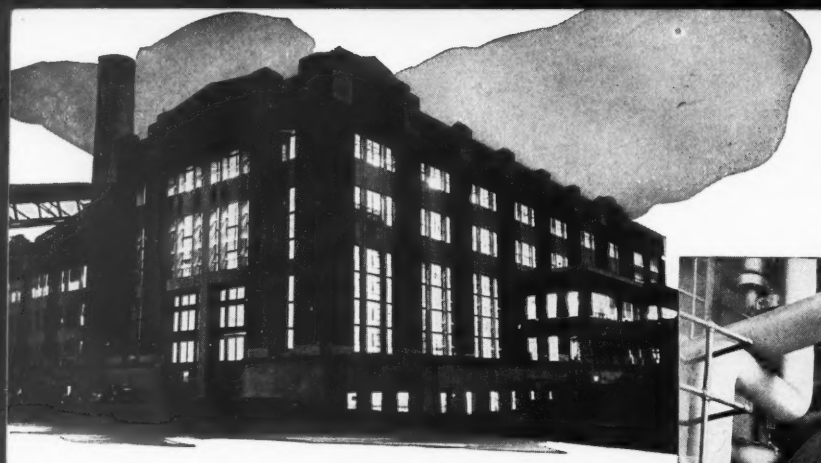
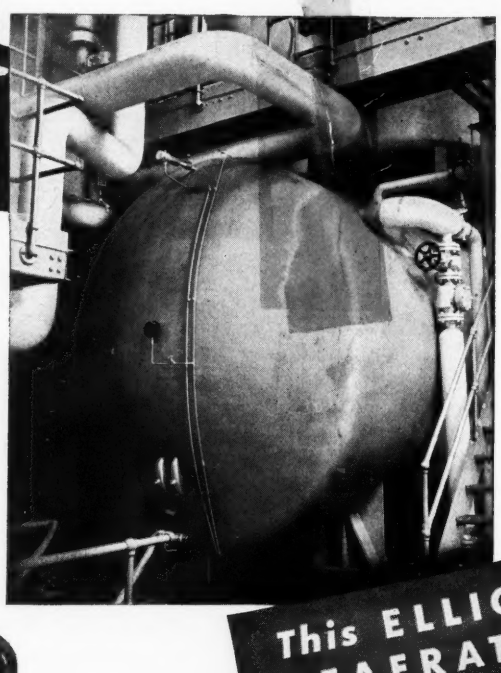
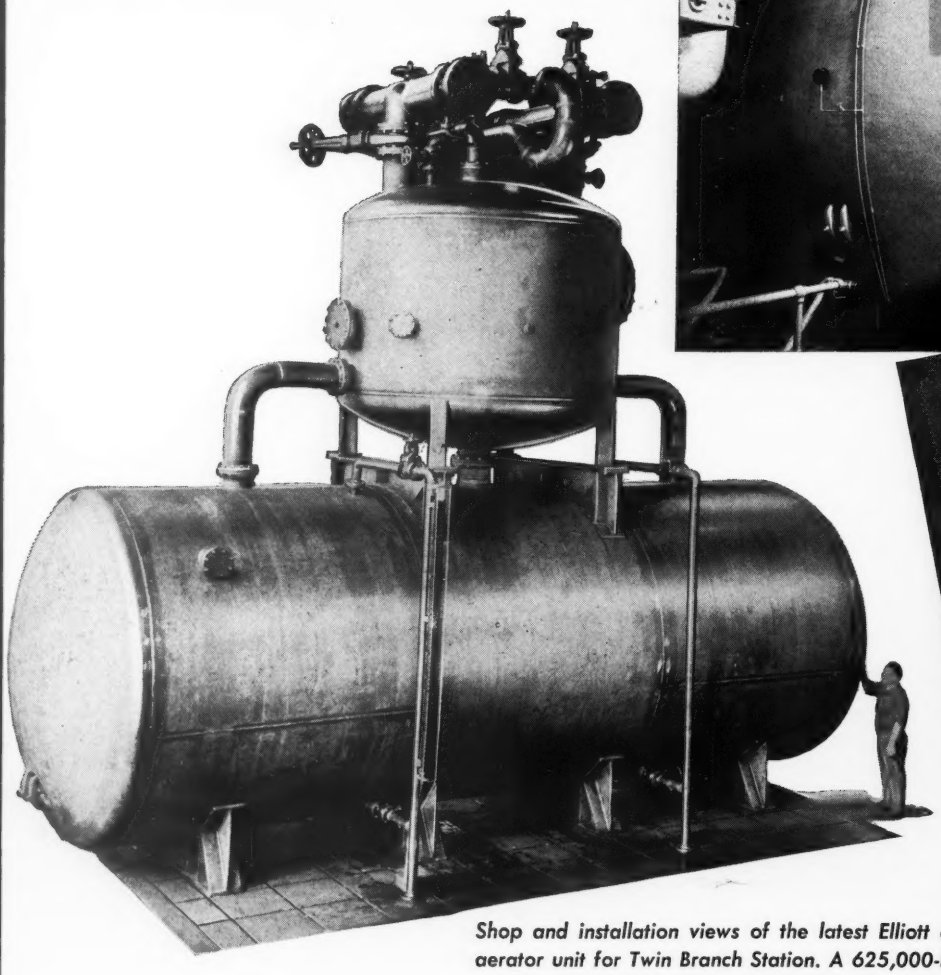






This ELLIOTT DEAERATOR provides . . . .

- Deaeration — zero oxygen
- Feedwater heating — to saturated temperature of steam supplied
- Water storage — in accordance with studied needs
- Feed pump protection features
- Minimum operating attention
- Engineering, design and construction, and
- Reliability of operation "Characteristically Elliott"

Shop and installation views of the latest Elliott deaerator unit for Twin Branch Station. A 625,000-lb.-per-hr. vertical deaerator is mounted on a horizontal storage tank, which has a capacity of approximately 15 minutes of deaerator rated capacity.

ELLIOTT

TECHNOLOGY DEPT

serves TWIN BRANCH

DEAERATORS • MOTORS • STRAINERS

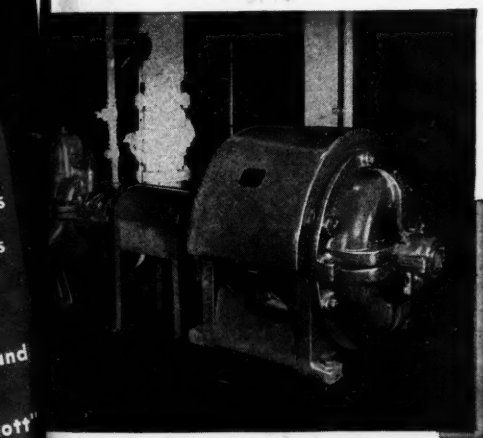
Striking boldly into the untrodden field of new high pressures and temperatures, the 2500-lb. Twin Branch extension of the Indiana and Michigan Electric Company is an achievement meriting the acclaim of the power industry. Elliott Company is proud to have had a part in equipping this outstanding station.

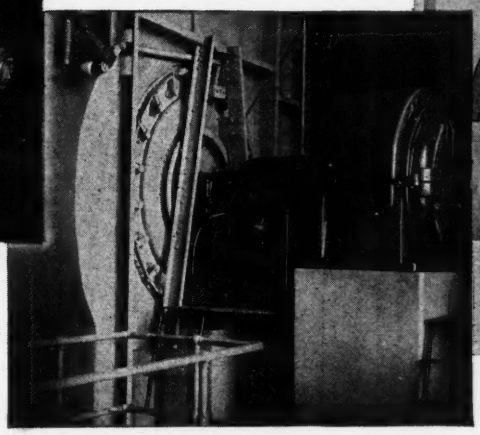
The Twin Branch extension gets "zero oxygen" feedwater, critically necessary because of the high operating pressure, with the Elliott deaerator illustrated at the left. An Elliott deaerator was chosen with confidence. The original station was protected by two Elliott 300,000-lb.-per-hr. deaerators. The new deaerator is more efficient both from a heat balance and an oxygen removal standpoint, reflecting progressive development paralleling that of essential power plant equipment. It removes *all* dissolved oxygen as indicated by the present most accurate measuring methods, insuring oxygen-free feedwater to protect vital equipment against corrosion from oxygen in the feedwater.

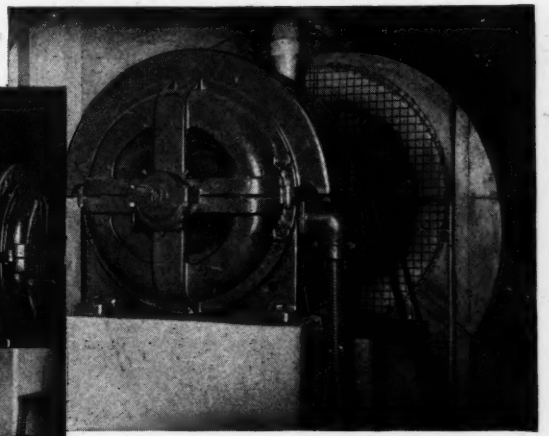
Only less important is auxiliary drive — and the new extension uses Elliott squirrel-cage induction motors to dependably drive fans for forced-draft, induced-draft, and primary air, as well as a service water pump. These motors are 800, 400, 250, and 150-hp.

Elliott strainers, too, are in use in both the earlier part of the Twin Branch Station, and the new extension. Three Elliott 10" single strainers insure clear water for the new boiler-feed pumps. And a number of twin strainers, in size from 3" to 14", serve various water lines.

As new power plant developments step forward, Elliott Company engineering is found ready with required equipment to carry the projects to success. Keeping pace with progress is an Elliott tradition.





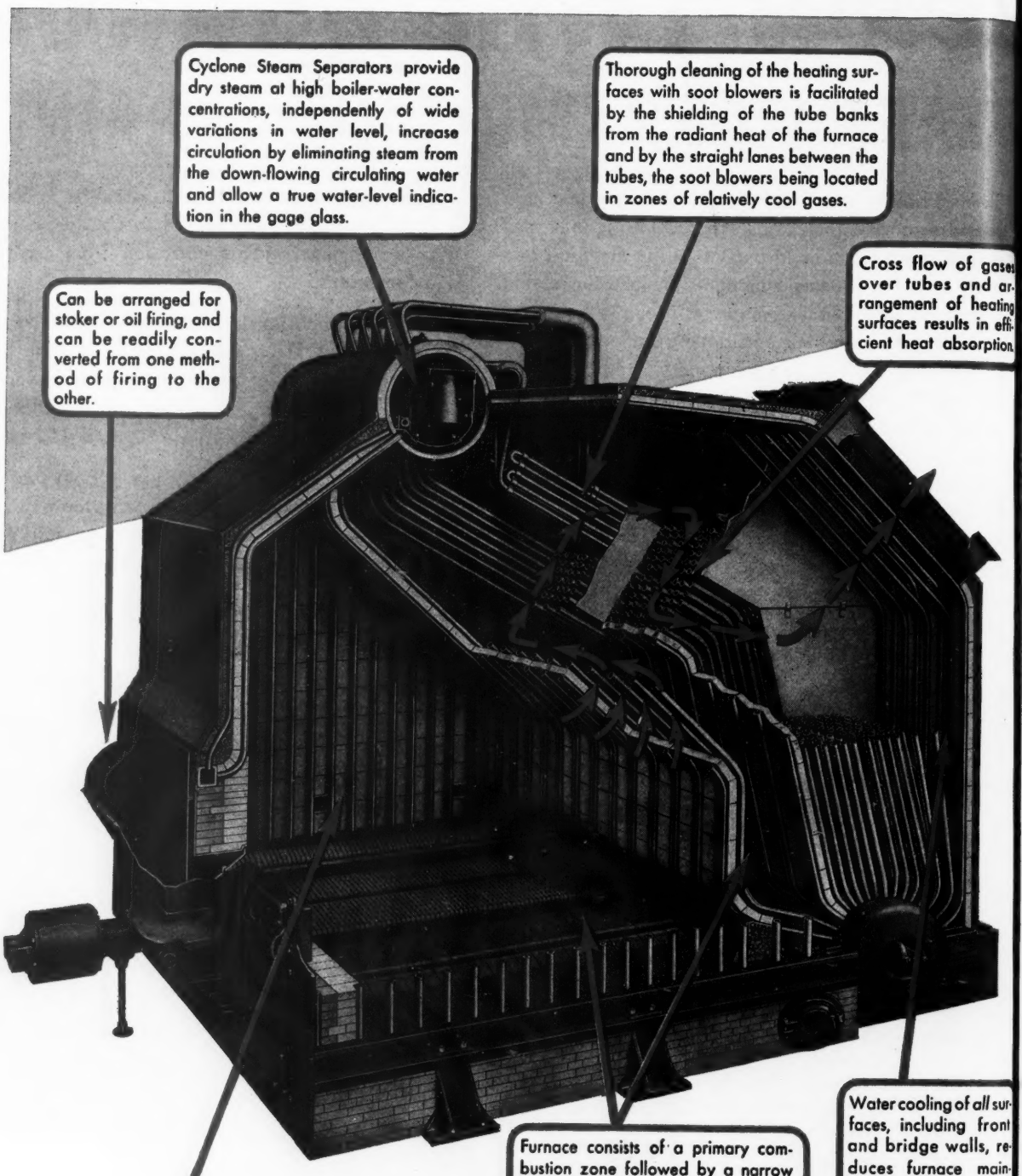


Three of the various Elliott squirrel-cage induction motors which serve Twin Branch. They range in size from 150-hp. to 800-hp.

Q-1078

COMPANY JEANNETTE, PA., RIDGWAY, PA.
SPRINGFIELD, OHIO
District Offices in Principal Cities

PRODUCTS: TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES • ENGINES • ENGINE-GENERATORS
MOTOR-GENERATORS • MOTORS • GENERATORS • CONDENSERS • STEAM JET EJECTORS • DEAERATORS
FEED-WATER HEATERS • DEAERATING HEATERS • CENTRIFUGAL BLOWERS • TURBO-CHARGERS • DESUPERHEATERS
STRAINERS • SEPARATORS • GREASE EXTRACTORS • NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS


Cyclone Steam Separators provide dry steam at high boiler-water concentrations, independently of wide variations in water level, increase circulation by eliminating steam from the down-flowing circulating water and allow a true water-level indication in the gage glass.
Thorough cleaning of the heating surfaces with soot blowers is facilitated by the shielding of the tube banks from the radiant heat of the furnace and by the straight lanes between the tubes, the soot blowers being located in zones of relatively cool gases.
Cross flow of gases over tubes and arrangement of heating surfaces results in efficient heat absorption.
Can be arranged for stoker or oil firing, and can be readily converted from one method of firing to the other.
Water cooling of all surfaces, including front and bridge walls, reduces furnace maintenance.
Furnace consists of a primary combustion zone followed by a narrow open-pass having higher gas velocity for the elimination of gas stratification by thorough mixing, which aids in the rapid completion of combustion. Complete combustion means SMOKELESS COMBUSTION.
Furnace design permits operation with low excess air, resulting in increased efficiency.

BABCOCK &

Over 60
INTEGRAL FURNACE BOILERS

TRADE MARK REG. U.S. PAT. OFF.

of Lower Capacities with Stoker or Oil Firing

already in service or on order

Although the Integral-Furnace Boiler adapted for stoker or oil firing in the smaller sizes was made available only recently, more than 60 of these units have already been purchased. The advantages of the unit are obvious, and of importance is the fact that they bring to plants requiring as low as 9000 pounds of steam per hour the benefits of large-boiler operation.

The more prominent features contributing to the high overall economy of this boiler are indicated on the drawing, although a feature not apparent is the standardization of design that affords additional benefits resulting from simplification in manufacture and erection, and simplified application of stokers.

Complete details of this unit, including data on sizes available and space requirements, are given in Bulletin G-34—sent on request.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK, N. Y.

WILCOX

G-214 T

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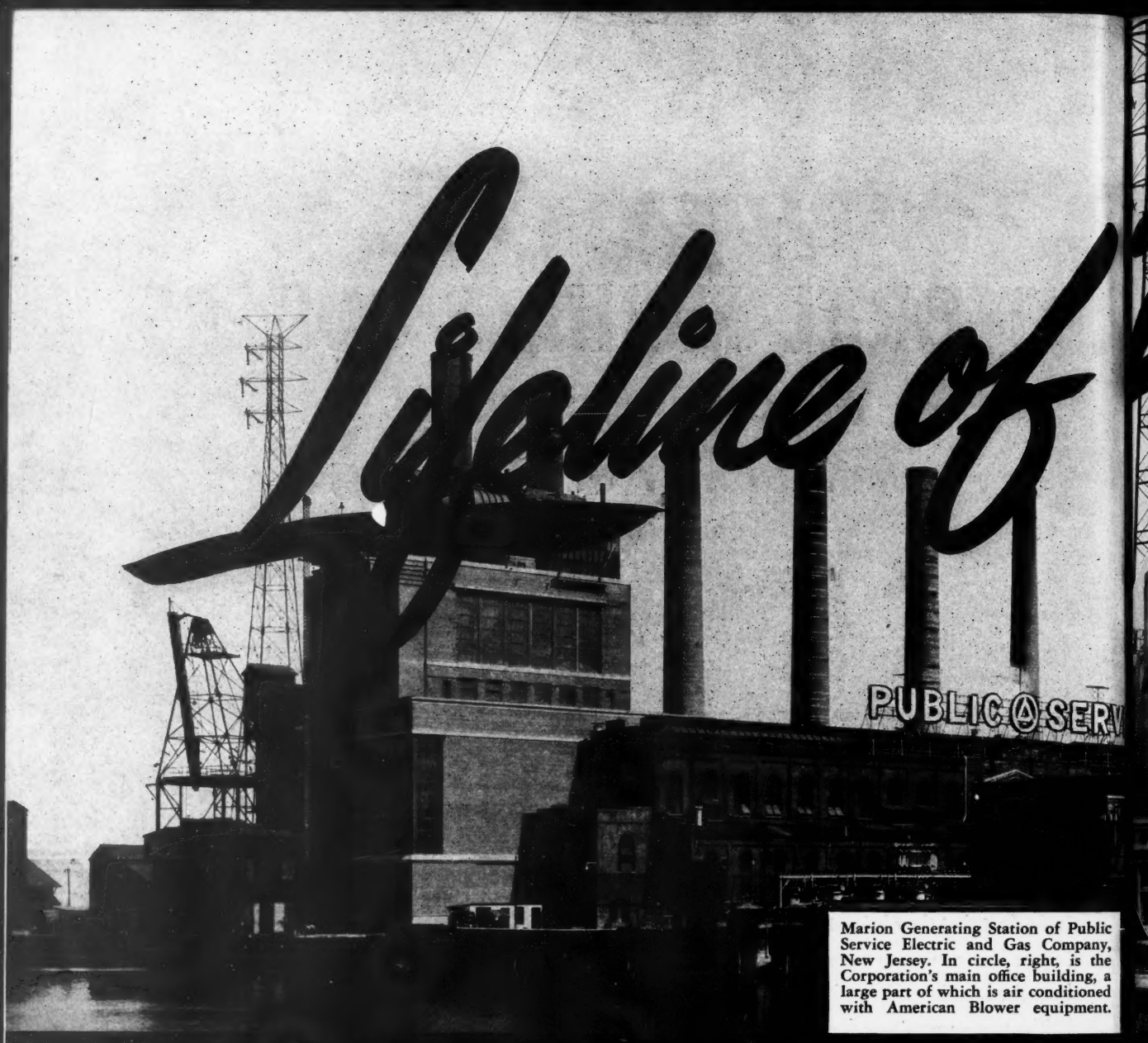
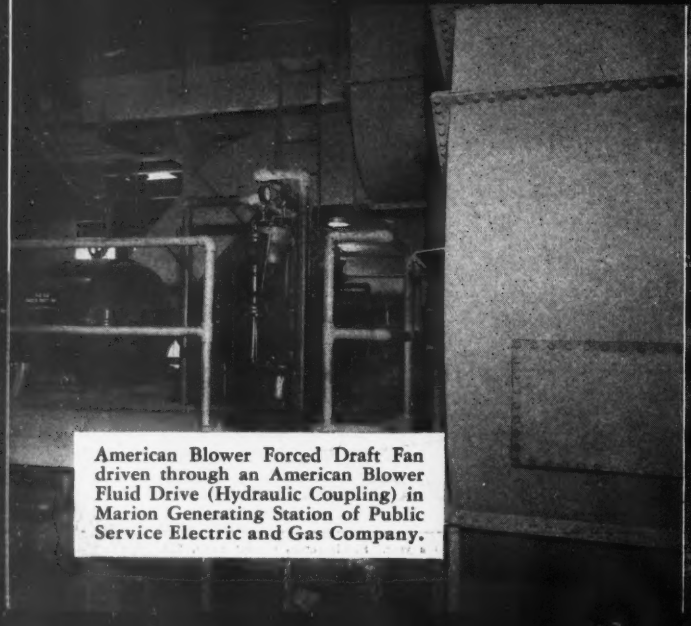
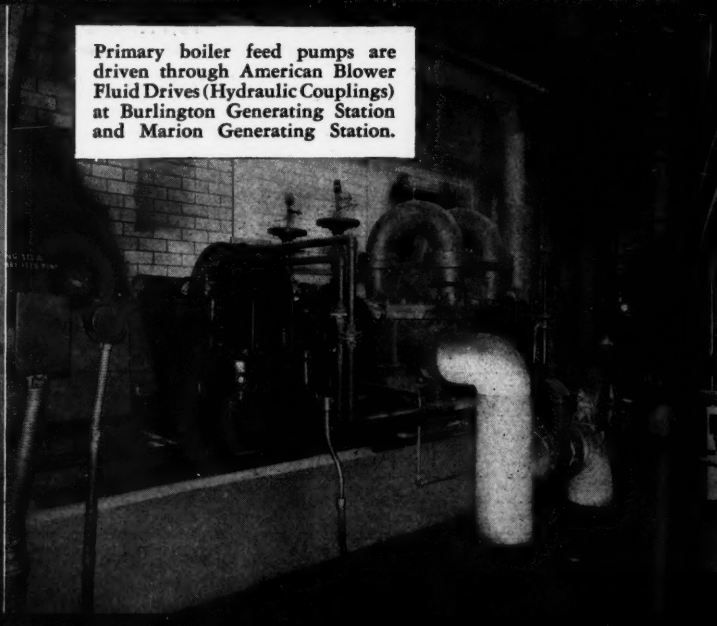


Marion Generating Station of Public Service Electric and Gas Company, New Jersey. In circle, right, is the Corporation's main office building, a large part of which is air conditioned with American Blower equipment.

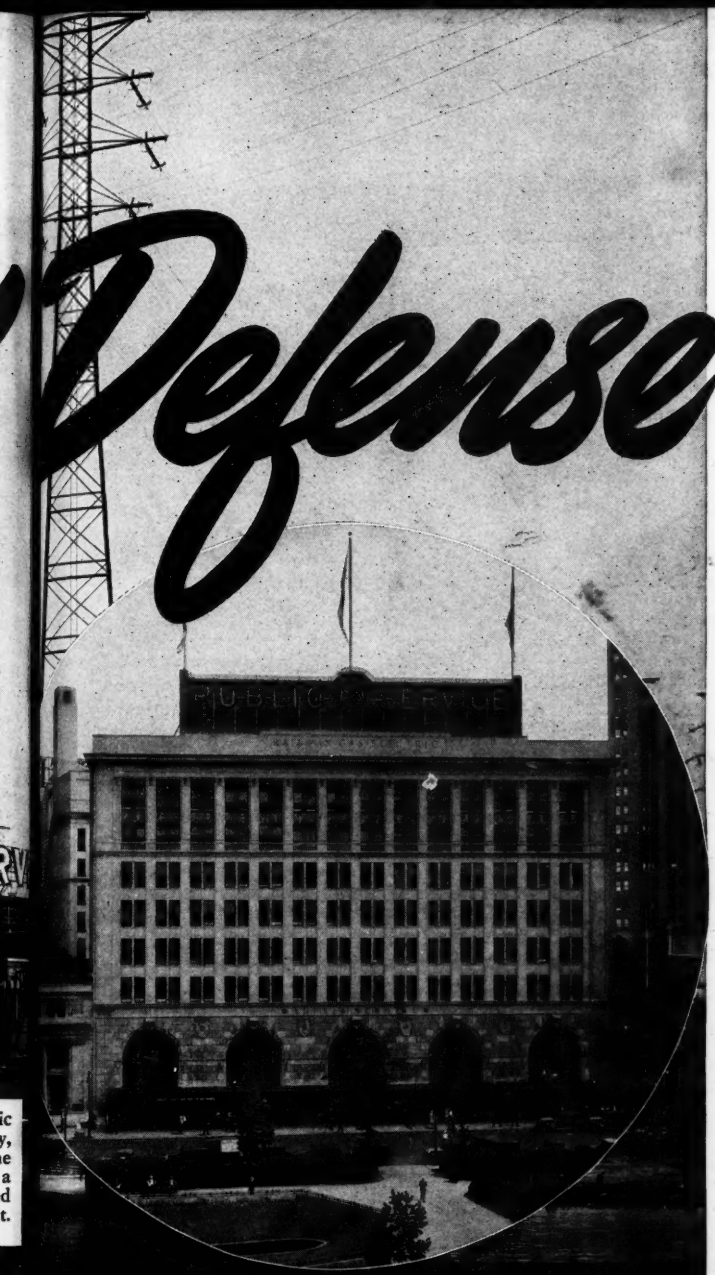
PUBLIC SERVICE CORPORATION OF



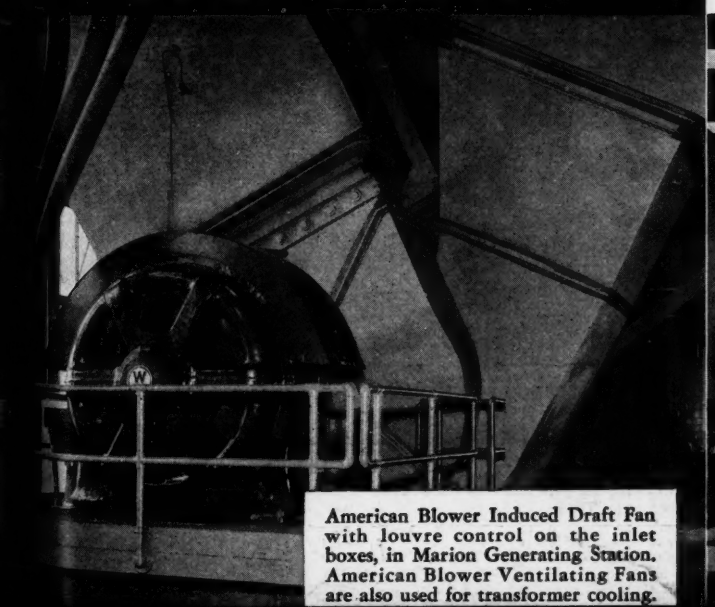
American Blower Forced Draft Fan driven through an American Blower Fluid Drive (Hydraulic Coupling) in Marion Generating Station of Public Service Electric and Gas Company.



Primary boiler feed pumps are driven through American Blower Fluid Drives (Hydraulic Couplings) at Burlington Generating Station and Marion Generating Station.



OF NEW JERSEY



American Blower Induced Draft Fan with louvre control on the inlet boxes, in Marion Generating Station. American Blower Ventilating Fans are also used for transformer cooling.

Always a symbol of progress, the electric power line is now, more than ever before, a lifeline of national defense. And the vital importance of Newark, metropolis of New Jersey, as an Atlantic seaport, railway, airway and highway terminus, and center of many defense industries, makes the responsibilities of the subsidiary operating companies of Public Service Corporation of New Jersey particularly great.

The Electric Department of Public Service Electric and Gas Company serves over a million customers. In addition to serving a highly industrialized and residential territory, over 84 per cent of the farms in this territory have been electrified. The Gas Department sells 30 billion cubic feet of gas a year. Public Service Coordinated Transport carries on the vehicles it operates a total of over 400 million passengers a year. A big job well done!

We are sincerely proud that American Blower Air Conditioning, Ventilating, Forced and Induced Draft Fans and Fluid Drives (Hydraulic Couplings) are a part of the modern, smoothly functioning equipment of Public Service Electric and Gas Company. And we should, likewise, consider it a privilege to serve you.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, 6000 Russell St., Detroit, Mich.
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO
Division of American Radiator and Standard Sanitary Corporation

This drafting room, in the main office building, is air conditioned with American Blower equipment.

Save FUEL
Save TIME
Save MANPOWER
GOOD TRAPPING is an Essential
ARMSTRONG TRAPS SAVE FUEL. Armstrong traps have tight-closing valves. There is no blow-thru of live steam under any load condition. You get full heat value out of every pound of steam.
ARMSTRONG TRAPS SAVE TIME. By getting rid of both air and condensate in a hurry, Armstrong traps enable you to keep equipment up to full capacity all the time. They help you hold full steam pressure in every chest, coil and jacket. They protect you against having excessive back-pressure build up in return lines.
ARMSTRONG TRAPS SAVE MANPOWER. Maintenance men in most plants have plenty to do without spending a lot of time repairing traps. Take advantage of Armstrong's trouble-free performance. Put an end to expensive maintenance. Use Armstrong traps for all jobs. Information and recommendations on request.
ARMSTRONG MACHINE WORKS
810 Maple Street
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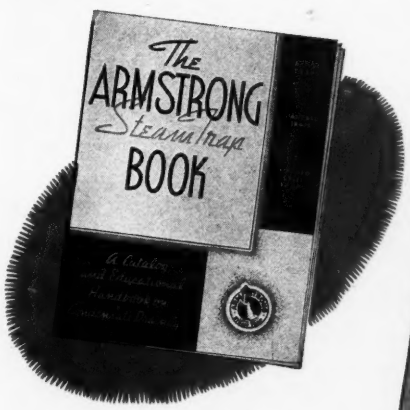
ARMSTRONG

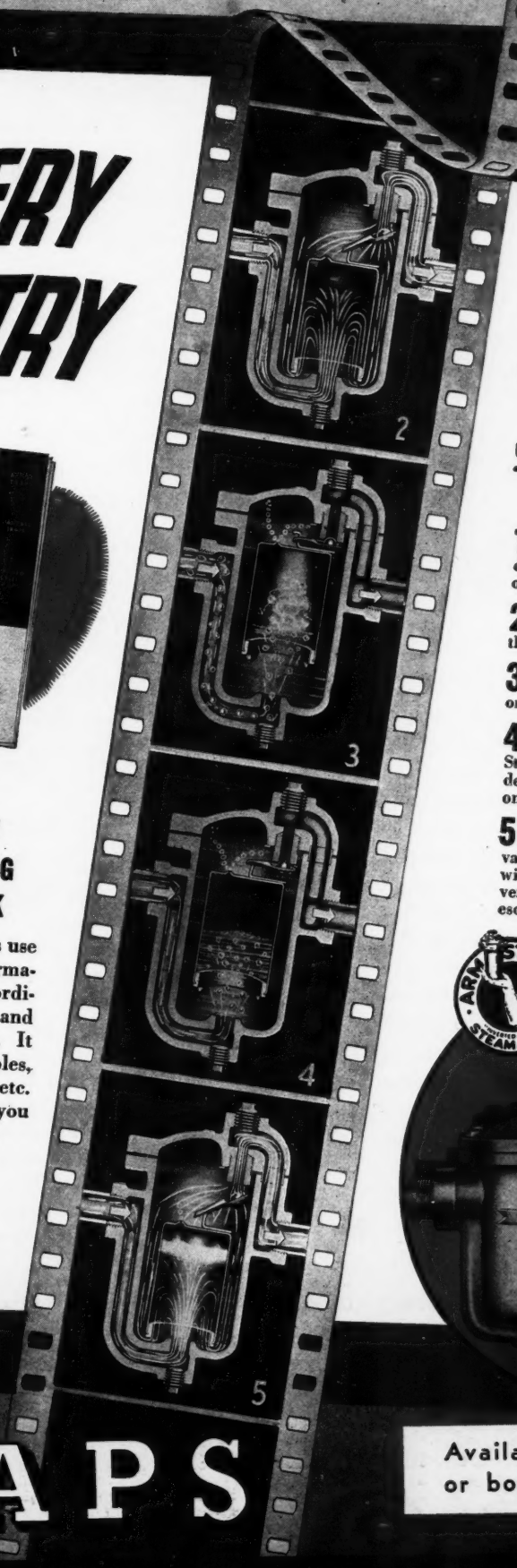
for EVERY INDUSTRY

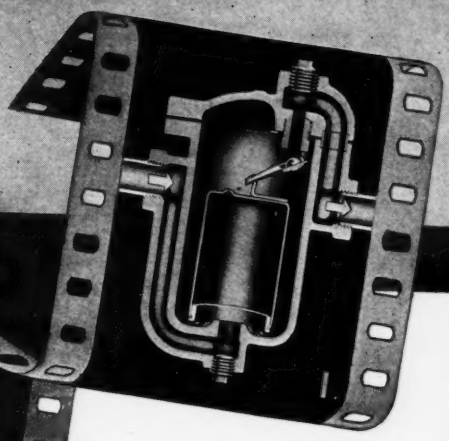


ASK FOR A COPY OF THE ARMSTRONG STEAM TRAP BOOK

THOUSANDS of engineers use this book to get all information needed to handle ordinary piping, heating, and drainage engineering jobs. It contains a wealth of tables, charts, curves, diagrams, etc. We will be glad to send you a copy without obligation.

SEE OUR CATALOG IN SWEET'S





Incorporating

the operating principle that gives you everything you want in a steam trap:

1. Top view shows trap when first installed. Steam off. Bucket down. Valve open. Inlet at left, outlet at right.

2. When steam is turned on, water fills body. Excess water escapes through orifice until . . .

3. Steam reaches trap and fills bucket, which floats and closes orifice.

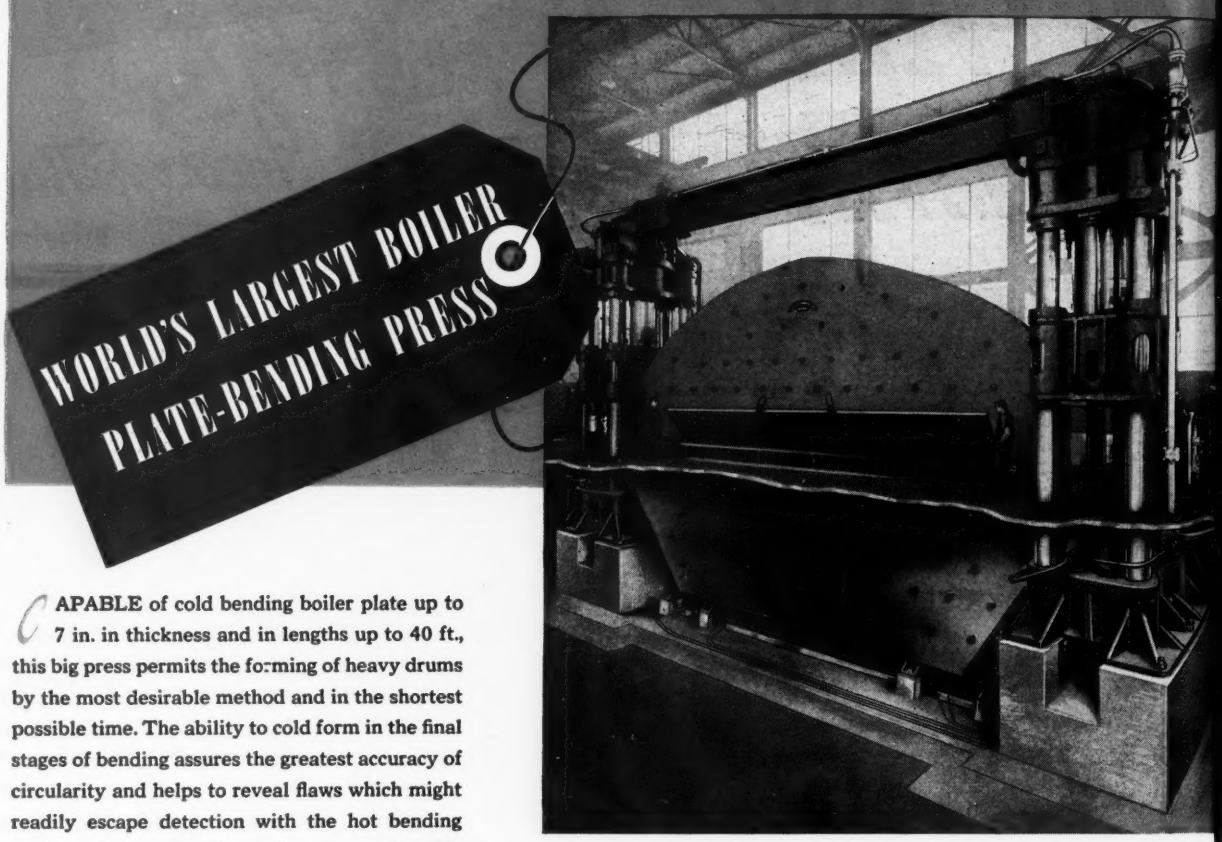
4. Inflow of more condensate displaces steam in inlet to trap. Steam in the inverted bucket condenses. Bucket loses buoyancy, pulls on valve lever.

5. When weight of bucket times leverage equals pressure on valve, trap opens. Air, carried in with steam, passes up through small vent in top of inverted bucket and escapes through valve orifice.

TRAPS

Available in side inlet or bottom inlet styles

A PAIR OF...



CAPABLE of cold bending boiler plate up to 7 in. in thickness and in lengths up to 40 ft., this big press permits the forming of heavy drums by the most desirable method and in the shortest possible time. The ability to cold form in the final stages of bending assures the greatest accuracy of circularity and helps to reveal flaws which might readily escape detection with the hot bending method. Operated at its maximum capacity, this press exerts a pressure of 6000 tons. Its overall height is 55 ft.; its beams, with attachments, weigh nearly 1,000,000 lb.; over 1000 tons of poured concrete were required for its massive foundation. Added to other presses of smaller capacity and heavy rolling equipment, it gives C-E unexcelled facilities for the manufacture of boiler drums.

With this combination of equipment, C-E has facilities which are unsurpassed anywhere for the forming and x-raying of heavy boiler drums.

These facilities made possible the use of *welded* drums for the new high pressure boiler to be installed at the Port Washington Station of the Wisconsin Electric Power Company. The drums for this boiler are the longest and among the heaviest welded boiler drums ever fabricated. Two are 60 ft. 10 in. long over heads and the third is 59 ft. long. All three have 5¼ in. thick walls.

With the world's largest boiler plate-bending press, it was possible for Combustion Engineering to form and fabricate

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

Giants

THAT PROVIDE WORLD'S FINEST FACILITIES FOR FORMING AND WELD-TESTING OF HEAVY DRUMS

these drums with greater precision and in far less time than is required with any other facilities available for such work.

With a 1,000,000-volt x-ray unit — the first equipment of this capacity to be ordered by any boiler manufacturer — C-E is able to test 5¼ in. welds with exposures produced approximately 70 times faster and with much greater diagnostic clarity than was possible with the best x-ray equipment previously obtainable.

This pair of giants are symbols of the progressive manufacturing policy which C-E applies to all its production operations — a policy which assures the highest quality of construction in all "C-E built" equipment.

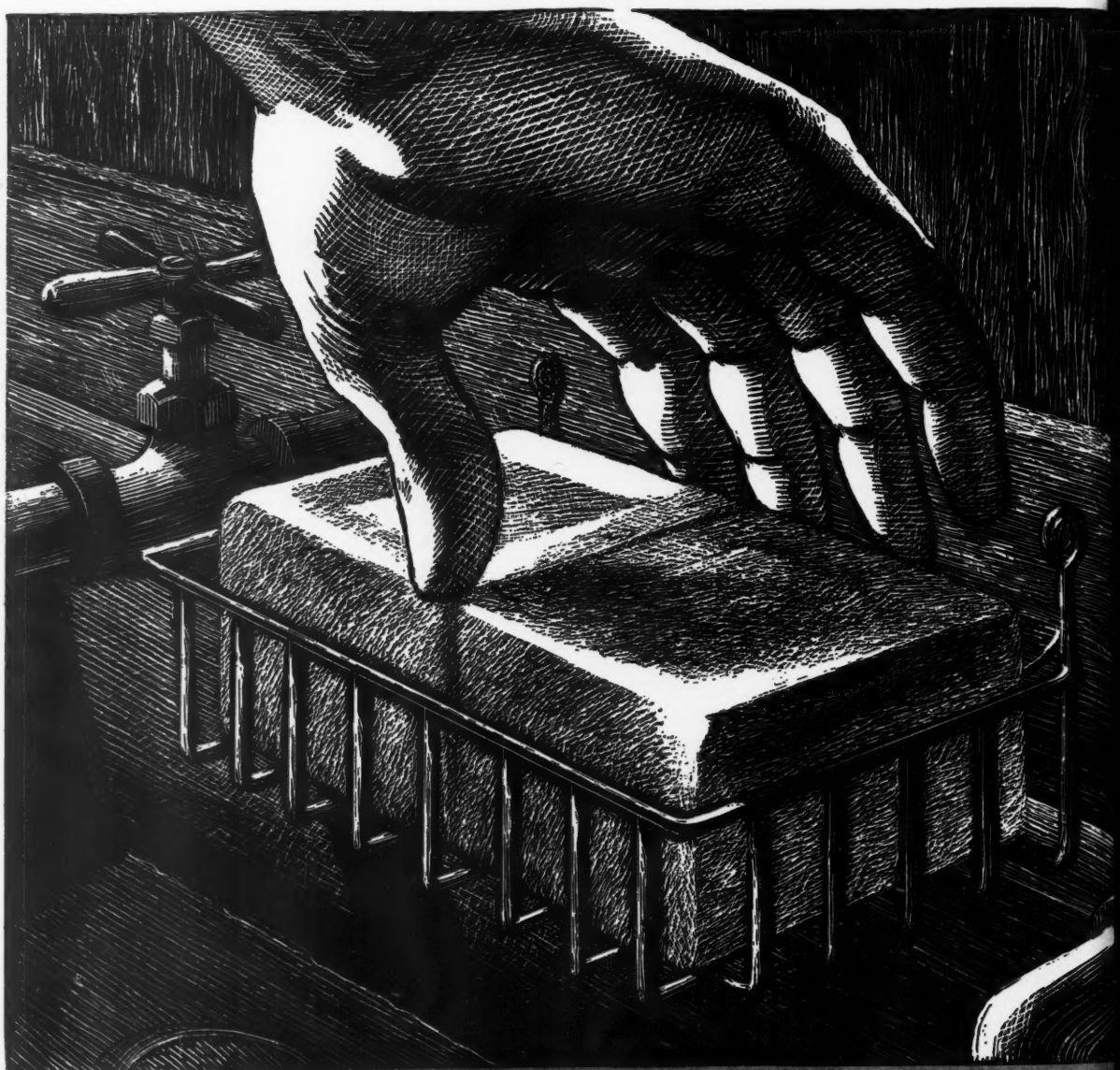
THIS most powerful x-ray unit, recently installed by C-E, exceeds by 600,000 volts the most advanced equipment previously available. One of its outstanding benefits is a notable improvement in radiographic results. The better quality of the negatives it produces provides a wealth of diagnostic detail that reveals the most inconsequential defects in the thickest of welded joints. Another big advantage is time-saving. For example, the new x-ray unit will radiograph a 4 in. thick plate 30 times faster; in about one minute, whereas the best previous practice required more than half an hour. For 5½ in. plate the new exposure time is 100 times faster. The unit is enclosed in its own specially designed building having the protection of 18 in. walls that extend five feet below ground for complete safety.

A-620

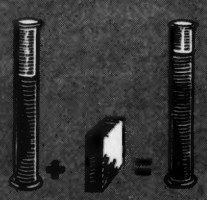
COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

ANTI-FRICTION BEARINGS . . . . A



Just as a sponge controls the water it has absorbed, so is soap a thickening agent which controls the flow of the lubricant to the bearings.



Maximum economical lubri cation per pound of grease i assured by the use of cylin der oil, making a minimum a soap necessary.

. . ARE NO LONGER "SOAP DISHES"

after changing to TYCOL GREASES

Anti-friction bearings were so caked with soap deposits from easily broken down grease that they could pass for "soap dishes." This accumulation of old, hard, soapy grease prevented the entrance of new lubricant, caused costly damage to the roller bearings from lack of proper lubrication. But the bearing "soap dish" era has gone and bearing worries are ended now that this steel mill is using Tycol Grease.

Why do Tycol Greases stand up in tough lubricating jobs where other greases soon run out or separate to form hard soap deposits? It's because Tycol Greases are made from the highest quality lubricating oils combined with a minimum of soap for a given consistency. Tycol Grease is water repellent, "stays put" indoors and out.

A Tide Water engineer will gladly help you maintain maximum production through proper lubrication. Full details may be obtained by writing the Tide Water Associated Oil Company, 17 Battery Place, New York, N. Y.

Regional Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

TIDE WATER ASSOCIATED OIL COMPANY

EASTERN DIVISION

17 Battery Place • New York, N. Y.

DRUMS, DRUMS, DRUMS!
Defense needs make it extremely important that all empty drums be returned immediately.

Veedol Motor Oil is another well-known product of the Tide Water Associated Oil Company

INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER GREASES

Tycol Green Cast Greases are made of paraffine stock cylinder oil which has high flash and fire points, with maximum film strength.

27 BOILER UNITS in ASSOCIATED GAS

1921 New York State Electric & Gas Company, Ithaca, N. Y., station, ordered one.

1922 Duplicate unit for New York State Electric & Gas Company.

1923 Metropolitan Edison, Middletown, Pa., station, ordered five.

1924 Broad River Power Co., Parr, So. Carolina, station, ordered one.

1925 New York State ordered one (Johnson City, N. Y., station); Metropolitan Edison ordered two for Middletown; Broad River ordered one for Parr; Broad River reordered one for Parr.

1926 Broad River ordered one for Parr.

1928 Broad River ordered one for Parr.

Foster Wheeler Corporation

FOSTER

20 YEARS for Sund ELECTRIC system

1936 Keystone Public Service ordered first Twin-Furnace unit for Oil City, Pa., station.

1937 Two 110,000 lb. steam per hr. units for New York State Electric & Gas Co., Dresden, N. Y., station.

1940 Keystone Public Service Co. ordered duplicate of 1936 unit for Oil City station.

South Carolina Electric & Gas Co.* ordered 162,000 lb. steam per hr. unit for Parr, S. C., station.

New York State Electric & Gas Co. ordered third unit of double capacity for Dresden station.

1941 Two more for N. Y. State's Westover station.

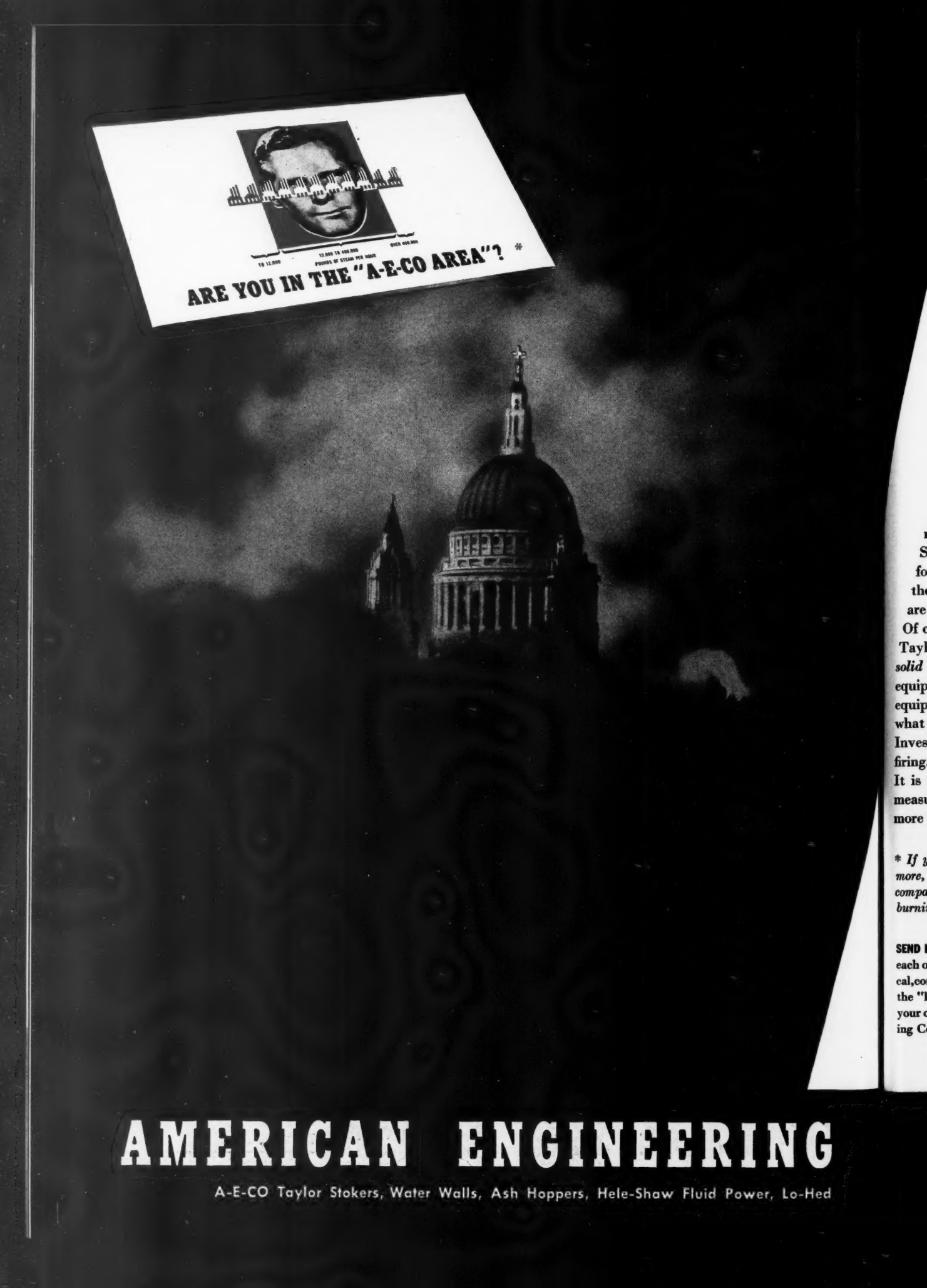
Two more for Metropolitan Edison Co., Middletown, Pa., station.

Two for N. J. Power and Light Co., Holland, N. J., station.

*Successor to Broad River Power Co.

165 Broadway, New York, N. Y.

WHEELER



AMERICAN ENGINEERING

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Hele-Shaw Fluid Power, Lo-Hed

SMOKE FROM THE FIRES OF LONDON COULD BE WORSE

Certainly—conditions in bomb-ridden London are appalling. Certainly—smoke from its burning buildings is only a minor factor. But if it weren't for Taylor Stokers, smoke conditions would be further complicated in London by the great, modern central stations turning out its power.

To Taylor Stokers the problem of stack discharge is of minor, almost inconsequential importance. But the problem of smoke *abatement* which faced the City of London several years ago was a major consideration in the installation of Taylor Stokers at Battersea, Deptford, and other of their more recently constructed plants.

You know the importance of smoke abatement right here in America, right in your own community. It is just one other problem which Taylor Stokers handle with much greater satisfaction. It is another reason for today's increasing trend to today's Taylor Stokers. And it is one of the *primary* reasons why central heating plants in centrally located areas are among the major users of the Taylor Stoker.

Of course you know exactly *why* smoke can be so readily controlled by Taylor Stokers. You know that, *since practically all the combustion of solid matter takes place on the grate*, a Taylor Stoker without fly ash equipment will discharge less than half the non-combustible of other equipment even with complex and expensive collection systems. And what *is* discharged by the Taylor Stoker is coarse and easy to catch! Investigate that carefully when you're considering a method of fuel firing. Investigate *every* advantage of Taylor Stokers—impartially! It is more than probable that you'll find Taylor Stokers actually measure up to your particular requirements with a more complete, more satisfactory "balance of power" factors!

* *If you operate between 12,000 and 400,000 pounds of steam per hour or more, you are in the A-E-CO Area! You must carefully investigate and compare every advantage of today's Taylor Stoker with ANY other fuel burning equipment!*

SEND FOR FREE BULLETINS—giving facts on each of the 12 factors influencing economical, continuous steam generation. Indicates the "balance of power" requirements for your own plant. Write American Engineering Co., 2408 Aramingo Ave., Phila., Pa.

Use These 12 Factors as a "Check Chart" in Demanding FACTS About Any Fuel Firing Equipment

RELIABILITY The Taylor Stoker has a 35 year record of reliability of which 92.7% is typical.

CAPACITY Emergency reserve capacity is readily available over long periods of operation.

MAINTENANCE Average is 3.4c per ton based on a recent study of a typical group of plants.

FLEXIBILITY From 40,000 to 300,000 lbs/hr in 72 seconds. Cold boiler, no fire, to 250% rating in 20 minutes.

EFFICIENCY 16.73c for fuel per thousand pounds of steam is indication of A-E-CO Taylor Stoker "dollar" efficiency.

OPERATION Simplest of any. No complicated adjustments. Coal direct from mine to hopper.

ADAPTABILITY Modernization can be accomplished without seriously disturbing existing plant structure.

FUEL FLEXIBILITY Handles coals of widely varying characteristics; detailed list on request.

REFUSE DISPOSAL Choice of 3 methods; power dump, continuous and rotary.

STACK DISCHARGE 90% average of ash to ash pit. Dust-recovery equipment rarely used—even in heart of city locations.

SPACE REQUIREMENTS Conforms to short and wide, or long and narrow furnaces.

OBSOLESCENSE One basic design used for 35 years enables new improvements to be added to numerous existing installations.

THE A-E-CO Taylor Stoker

COMPANY

Hoists, Marine Deck Auxiliaries

Choice of

This beautiful new building at Wilmington now houses all departments of the 50-year-old Delaware Hospital and provides space for 350 beds. Architects, Messena & duPont, Wilmington.

YARWAY

Modern Institutions

WHERE 100% dependability is paramount —as in hospital service—Yarway Blow-Off Valves are usually the choice.

Good example—Delaware Hospital's new boiler plant—show-place of modern efficiency, reliability and operating economy. Here the three 160-lb pressure boilers, with a total rating of nearly 50,000 lb of steam per hour, are equipped with three Yarway Double-Tightening and Seatless Tandem Blow-Off Valves.

This valve arrangement, which combines the quick-opening, straight-through-flow advantages of the Yarway Double-Tightening Valve, with the positive sealing effect of the Yarway Seatless Valve, is the popular favorite with many thousands of lower-pressure power and heating plants.

Whatever your Blow-down valve requirements, there is a Yarway Valve combination designed expressly for that service. Write for Catalog; section B-421 for pressures up to 400 lb, section B-430 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
114 Mermaid Ave. Philadelphia

There is a Yarway Blow-Off Valve for Every Pressure, Purse and Purpose

At Right—Yarway Double-Tightening and Type B Seatless Tandem Valve. Available in iron for pressures up to 200 lb; in steel for pressures up to 300 lb.

Above—Yarway Type B Seatless Tandem. Available in iron for pressures up to 200 lb; in steel for pressures up to 400 lb.

At Right—Yarway Type C Seatless Tandem Valve made in steel only for pressures up to 600 lb.

BLOW-OFF VALVES

Power supplied by the oscillator vibrates the buckets through a rod connected to a loudspeaker-like device.

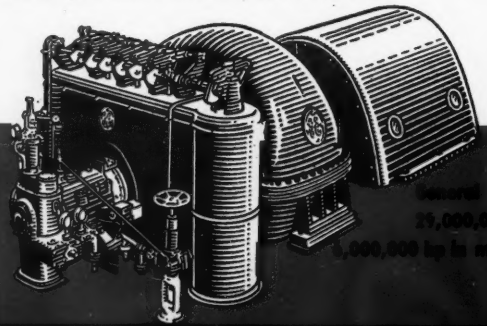
Engineers move the crystal detector along the bucket tips and relay the bucket's vibrations to the oscillograph. Points of peak vibration are noted.

On the screen of the oscillograph the vibrations are magnified 100,000 times to show the frequency at the turbine bucket.

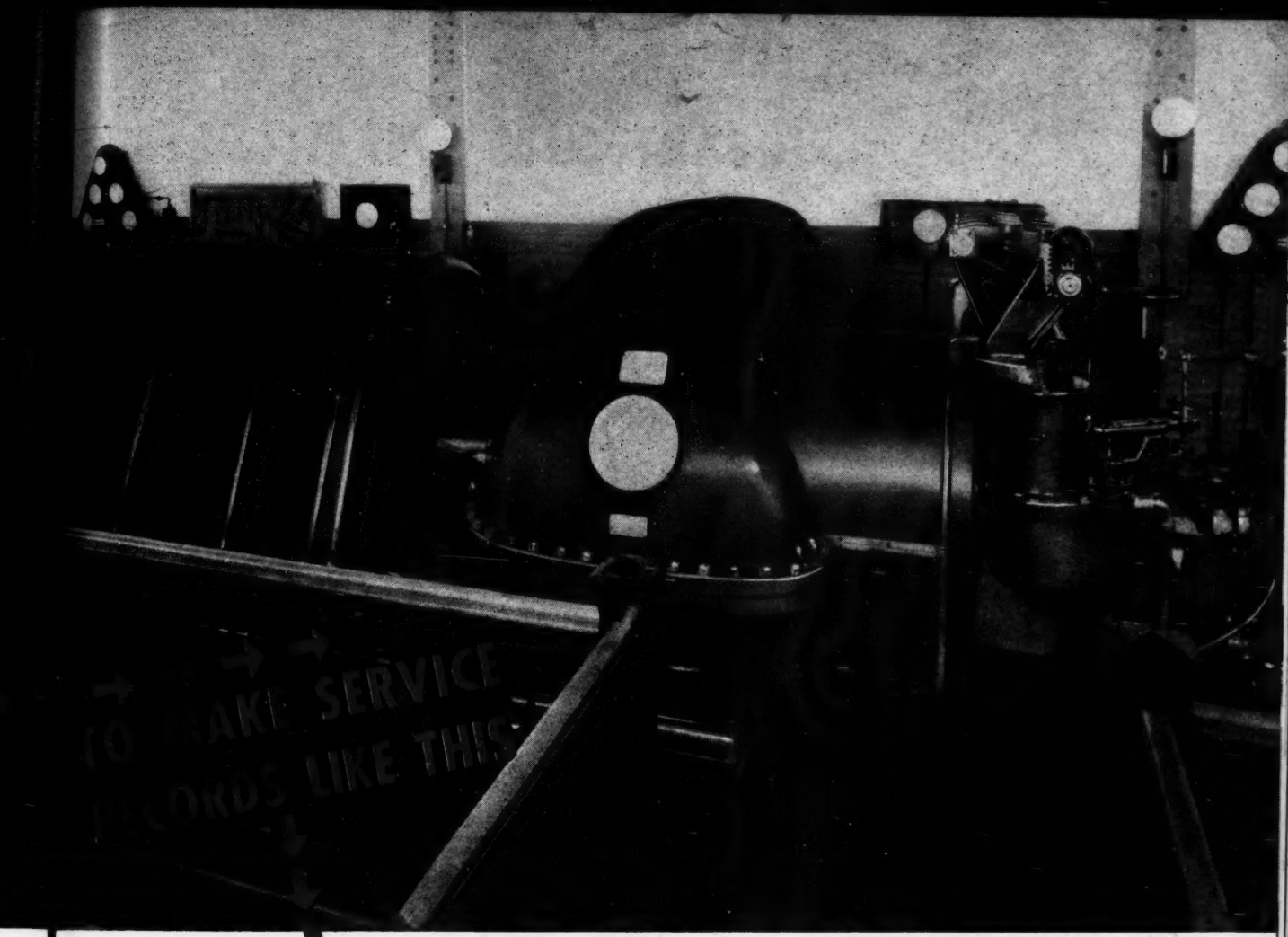
WITH the high temperatures in use today and wheel-tip speeds exceeding 800 miles per hour in many units, it is essential that every feature of bucket design and construction be thoroughly tested. Our turbine designers are constantly studying vibrations in these buckets, but until recently it has been difficult to make comprehensive tests on the shorter ones because of their very high natural vibration frequency—a condition almost impossible to reproduce outside the turbine with sufficient strength for study. The problem of artificially producing and recording such vibrations resulted in developing specialized test equipment—a 1000-watt audio oscillator which produces power at frequencies of 30 to 20,000 cycles per second.

The oscillator (above) produces and delivers power at constant frequency to a loudspeaker-like device which vibrates the turbine buckets. As the buckets vibrate, the engineer moves a crystal vibration detector along their tips to relay their resultant frequency to an oscillograph. By watching the oscillograph screen—where the bucket vibration is magnified 100,000 times—he can study the vibration pattern and then so design a wheel that resonance will not occur at normal speed.

General Electric turbine engineers make use of many other tests. This attention to detail adds to the assurance that the completed turbine will perform up to G-E standards. The results of experienced and skilled manufacture and test are reflected in our large number of repeat orders from leading utilities and industrial plants.



General Electric has built more than 29,000,000 kw in turbine-generators and 4,000,000 hp in mechanical-drive and marine unit.



10 years of continuous service
Less than $450 for renewal parts
200,000,000 kilowatt-hours generated

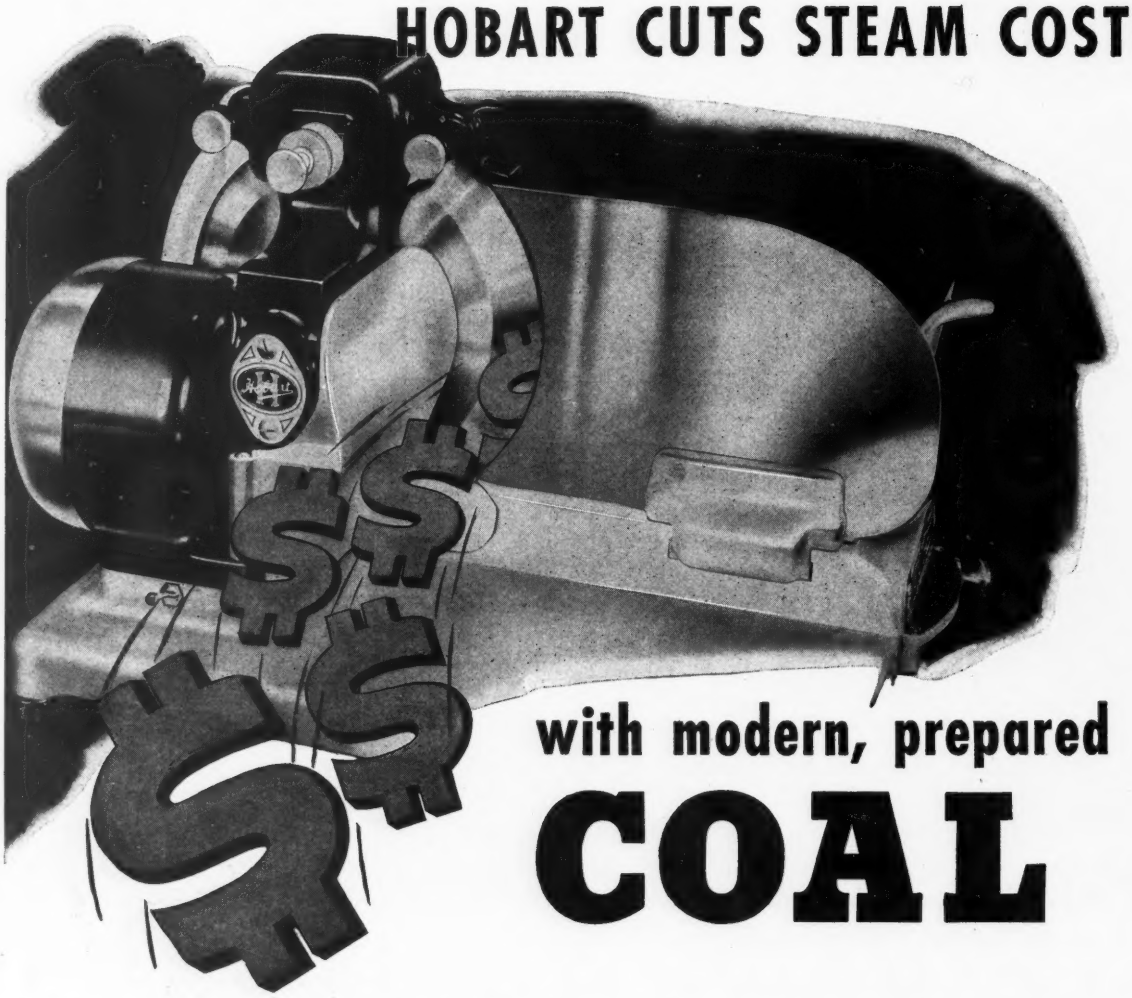
THAT'S the performance record achieved by one General Electric turbine-generator—in a North Carolina power plant. Every operating hour for ten years, this 5000-kilowatt unit generated dependable, low-cost power without a single mechanical failure. Minor renewal parts—mostly packing materials—cost less than $45 a year. Today, this turbine is helping to carry peak loads as a stand-by unit, while a later 7500-kilowatt, 700-degree, 250- or 450-pound unit, which has been in operation two years, has consistently exceeded the performance guarantee. Coal consumption has been reduced from an average of 1.75 pounds per kilowatt-hour to 1.25 pounds, with a one-day low of 1.14 pounds.

Twenty-six years ago a G-E turbine-generator—a 500-kilowatt unit—was installed in this plant. When additional units were required—five, ten, fourteen, and twenty-four years later—"General Electric" was specified each time. These repeat orders were earned by good engineering.

Whatever the steam conditions, the buyer of a General Electric turbine is assured of superior all-round performance, for in it are combined the results of more than 40 years of constant research and development. The turbine specialist in our nearest office can give you valuable assistance in connection with the use of turbines, not only for power generation but also for mechanical drive. He will be glad to work with you or your consulting engineers in the selection of the right equipment. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

HOBART CUTS STEAM COSTS



with modern, prepared COAL

POWER AND STEAM requirements at the Hobart Manufacturing Company, Troy, Ohio, are typical of the average medium-sized plant. This Company makes equipment for the preparation of food, such as meat choppers, food mixers, and potato peelers; and the merchandising of food, such as computing scales, coffee mills and meat slicers. It uses a large quantity of process steam. Part of its electric power is purchased, part is generated at the plant. New boiler equipment, recently installed, places the Company in a position to expand its power facilities when conditions justify. And the fuel? Modern, prepared COAL from the great bituminous fields served by Chesapeake and Ohio Lines.

"We rely on coal," says Mr. Vernon Edwards, chief engineer of the Hobart power plant, *"for dependable, trouble-free operation, higher efficiency and lower steam costs."*

Let our engineers point out POWER ECONOMIES in YOUR PLANT

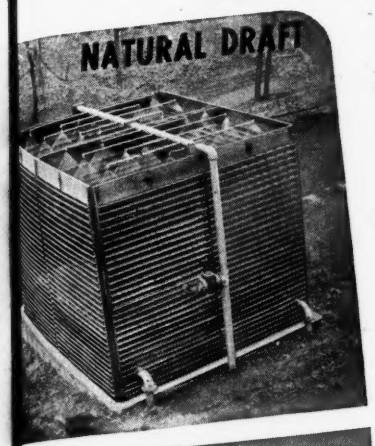
The aid of Chesapeake and Ohio Fuel Service Engineers is given without cost to industrial plants requesting it. These fuel experts are consultants. They will visit and survey your plant, confer with your engineers and make practical suggestions for lowering steam costs, raising boiler efficiencies, reducing maintenance costs. Take advantage of this service. It may show you the way to extensive savings! Simply write to GEORGE H. REINBRECHT. Coal Traffic Manager, Chesapeake and Ohio Lines, 2903 Terminal Tower, Cleveland, Ohio.

IT PAY$ TO U$E MODERN ...

Chesapeake and Ohio Lines

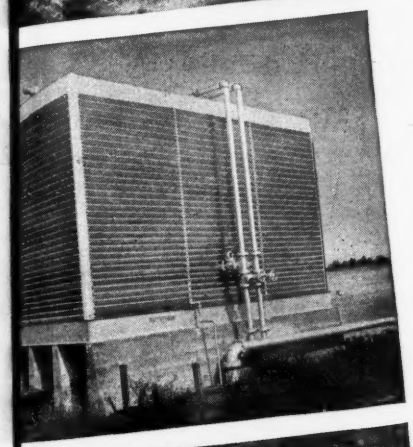
PERFORMANCE *is the Final Test of Value*

So Look at the PERFORMANCE RECORDS



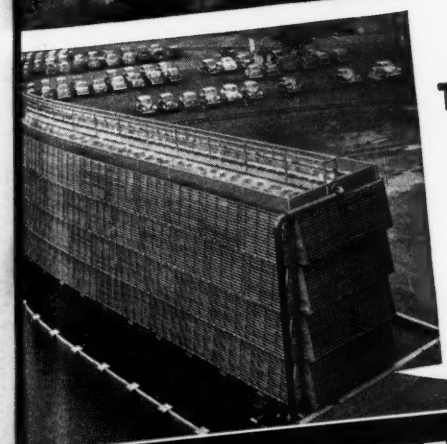
1. Solid facts and figures, the results of numerous tests conducted at random among the hundreds of Marley cooling towers operating in every kind of industrial and air conditioning service, prove the reliability of Marley's definite performance guarantees.

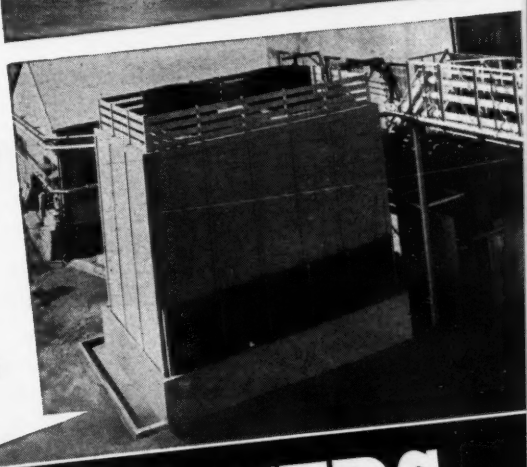
2. Also compare the other indicators of satisfactory performance: the manufacturer's percentage of repeat orders, the number and calibre of companies that are regular purchasers, the volume done by the manufacturer as a percentage of the total cooling tower volume for all manufacturers, the facilities and reputation which are the only factors giving value to any manufacturer's performance guarantees.



Look at the *whole* record and buy on the basis of proved performance! Without obligation, receive Marley's recommendations on any question involving water cooling equipment. In 36 major cities or write—

The MARLEY Company
Fairfax and Marley Roads
Kansas City, Kansas





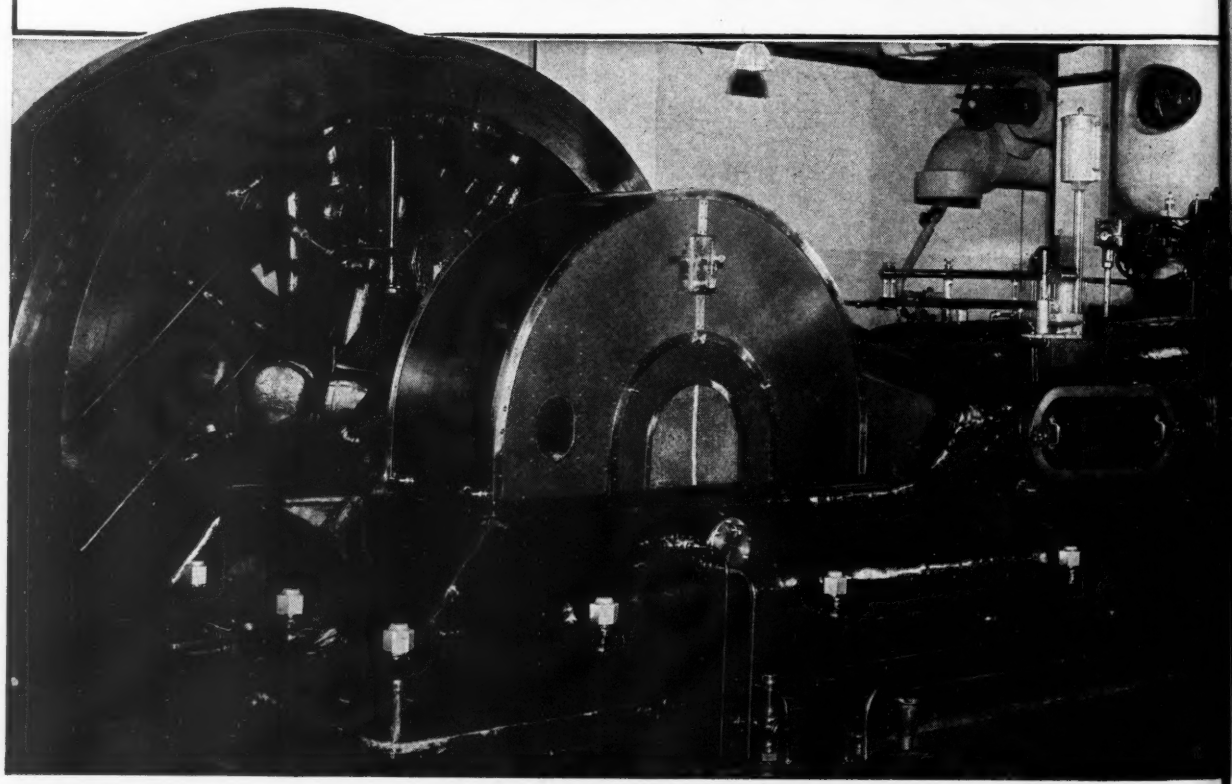
ALL TYPES, ALL SIZES
and all variety of specialized adaptations to fit individual needs precisely.

MARLEY COOLING TOWERS

are saving money and promoting efficiency in plants, smallest to largest, in all phases of industry

Boilers and Exhaust Steam Stay Clean_

WITH GARGOYLE CYLINDER OIL IN YOUR ENGINE



CALL IN Socony-Vacuum for

YOU'LL BENEFIT FROM: 75 YEARS' LUBRICATION EXPERIENCE • PRODUCTS APPROVED BY ENGINE BUILDERS •

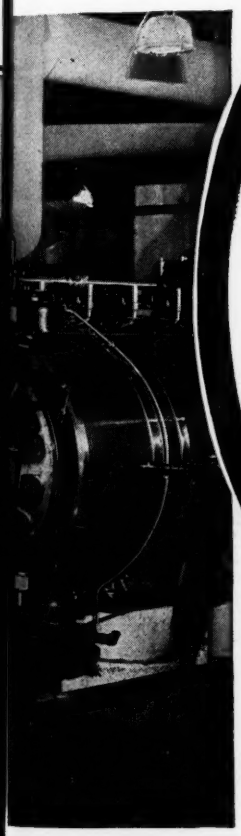
Here are two important operating advantages that Gargoyle Super Cylinder Oil 600-W offers you:

Because this oil separates quickly from condensate, it minimizes oil in your boiler.

That means you get maximum heat transfer through boiler tubes.

And because this high-quality cylinder oil lubricates your engines efficiently with minimum feeds, it helps keep exhaust steam clean.

Result—you get peak efficiency for heating and processing equipment.



GARGOYLE

Lubricants

The Emblem of
75 YEARS' PIONEERING
in "Correct Lubrication"
1866-1941

"Correct Lubrication"

THE RIGHT OIL FOR EACH JOB • NEW LUBRICANTS AHEAD OF NEW NEEDS •

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of New York Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp. of Calif.

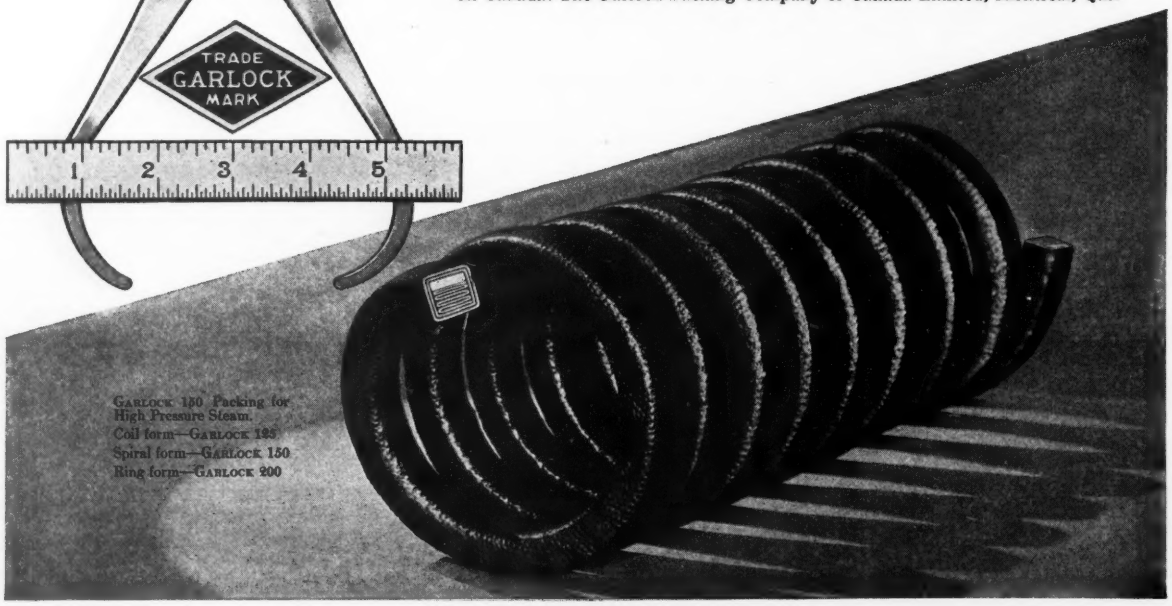
WHEN YOU THINK OF PACKING—

Think of Garlock

THE name GARLOCK is known to tens of thousands of engineers and purchasing agents as indicating the *Standard Packing of the World*. Our Quality Controlled method of manufacture assures finished products that are right in quality of material, uniform in excellence of workmanship, correct in measurements, and in conformity with our established standards. You can rely on GARLOCK Packings for long, dependable service.

THE GARLOCK PACKING CO., PALMYRA, N. Y.

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.



GARLOCK 150 Packing for High Pressure Steam.
Coil form—GARLOCK 125
Spiral form—GARLOCK 150
Ring form—GARLOCK 200

HERE'S FLEXIBLE PUMPING POWER

IN ONE TIGHT PACKAGE...

Allis-Chalmers "Electrifugal" Pump Unit LEADS THE FIELD WITH 5 GREAT FEATURES And Cuts Your Costs Up To 33%!

LOOK at the outstanding engineering advancements of this "Tri-Fit" construction . . . its streamlined, compact design! One integrated frame with one precision-made driving shaft means fewer parts, fewer fits, better balance and smoother operation . . .

Even its motor has been specially developed for pump drive — far stronger mechanically and completely splash-proof.

Indestructible rotor and distortionless stator are removable for easy access and quick inspection. Large, sturdy ball bearings . . . splash-proof ventilation . . . cast bronze protective sleeve and cast aluminum fans are just some of the other outstanding features of this modern pump.

Best of all . . . *you can actually cut your initial costs as much as 33% over conventional pump installations.*

For the whole story of the money-saving facts on this "One Package" Pump . . . and how it can help you get *more gallons at less cost* . . . call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis., for Bulletin B-6140.

A 1420

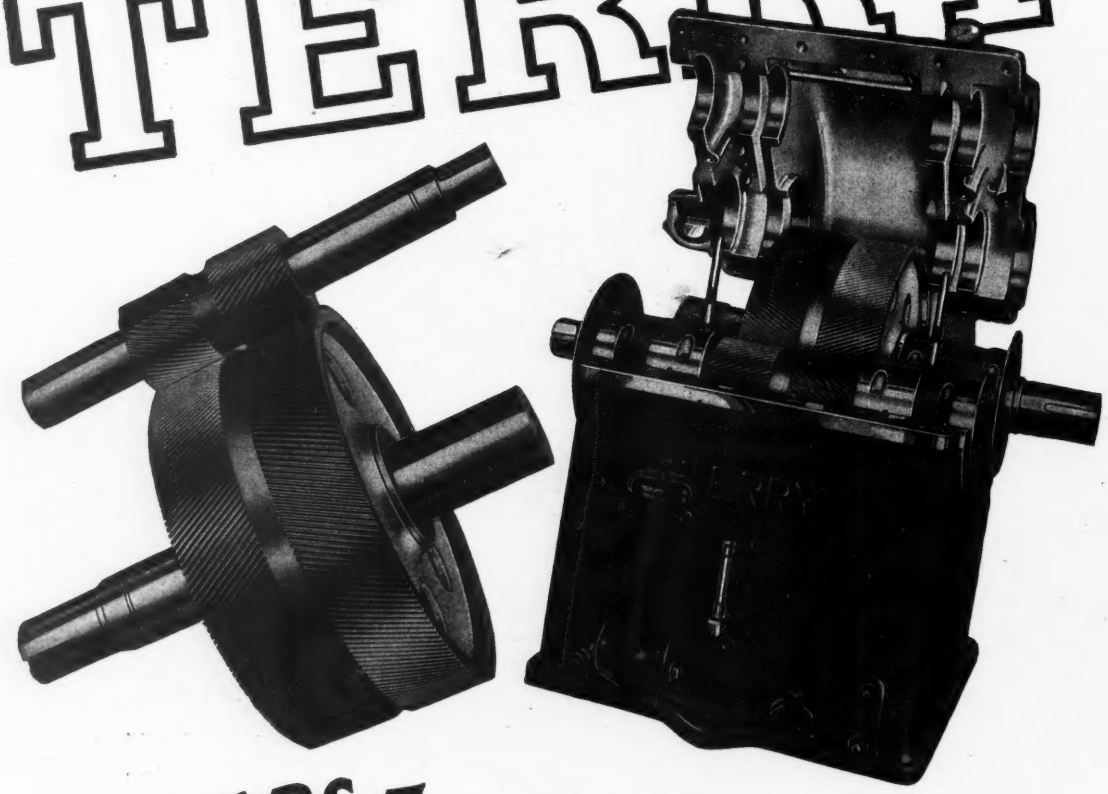
CHECK THESE ALL-OUT ADVANTAGES AND SEE WHY:

1. *Up to 33% Space Saved* with one frame, one solid driving shaft construction.
2. *Overhang Cut As Much As 40%.* Four solid supports assure precision balance . . . ease strain on vital parts.
3. *New "Tri-Fit" Design* eliminates 2 section fits for more positive shaft alignment, wear-less and vibration-free performance.
4. *Splash-Proof Motor* standard equipment . . . 100% designed for pumping.
5. *Easy-to-Get-at Casing* simplifies stuffing box and waterseal gland inspection.

Allis-Chalmers Pumps Can Handle "Anything that Flows"

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

TERRY



GEARS — FOR SPEED INCREASING OR SPEED REDUCING

The Terry gear has been developed to handle the high speeds and powers that are associated with steam turbine installations. It has been used successfully in thousands of plants in connection with turbines, high speed centrifugal compressors and the like.

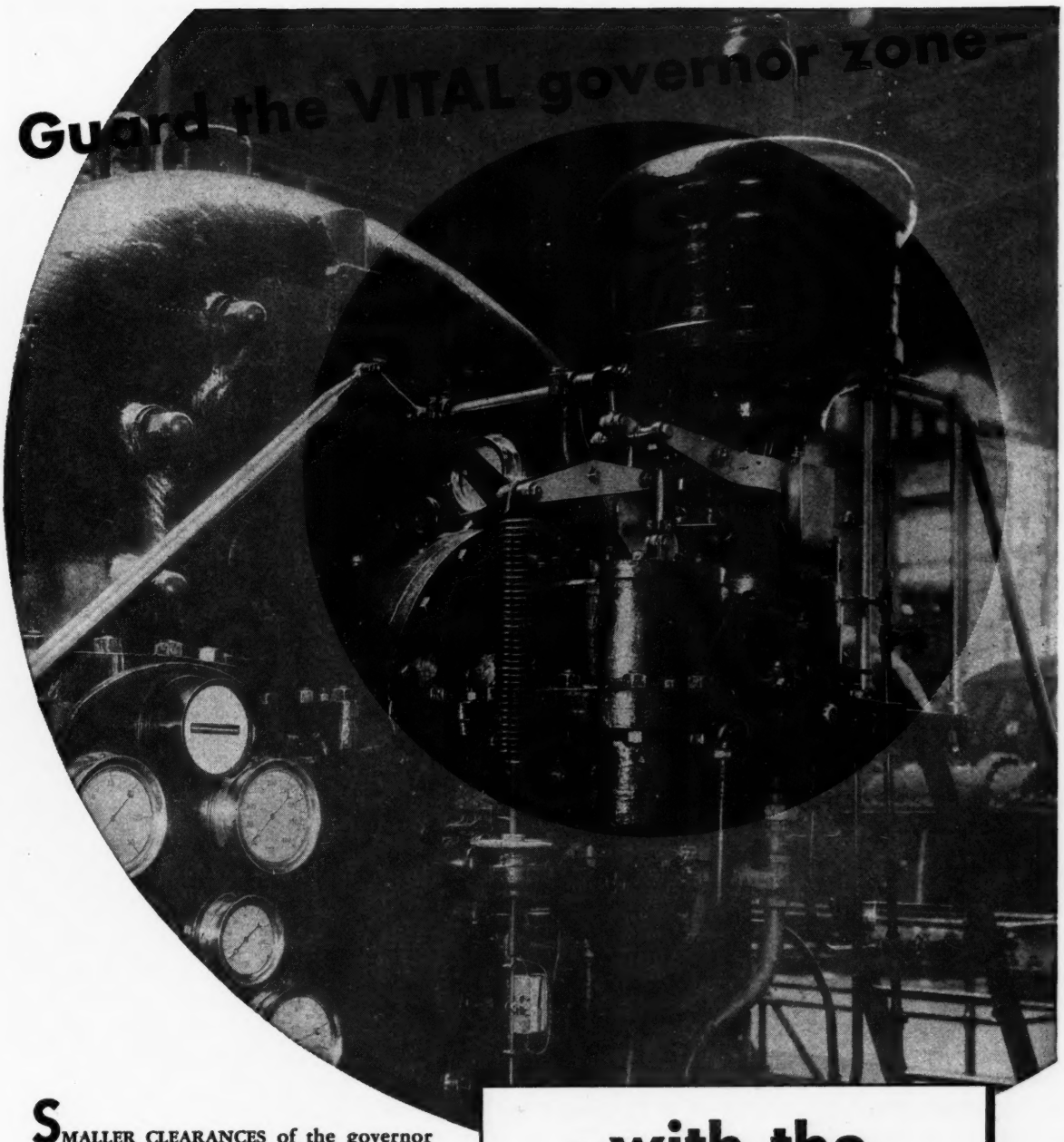
Each Terry gear is carefully engineered to suit the installation. All rotating parts are accurately balanced. Forced feed lubrication is used on the bearings and the meshing teeth. The teeth are double helical and are generated on precision gear cutting machines. The bearings are of the babbit lined sleeve type and are unusually heavy so as to prevent distortion under load.

Full details of the Terry gear are included in our bulletin S-130. A request on your business letterhead will bring a copy.

Above: Typical Terry high speed gear. Accurate fixtures and gauges insure that the boring of the case is in perfect alignment and that standard bearing shells will exactly fit and be interchangeable.

T-1145

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



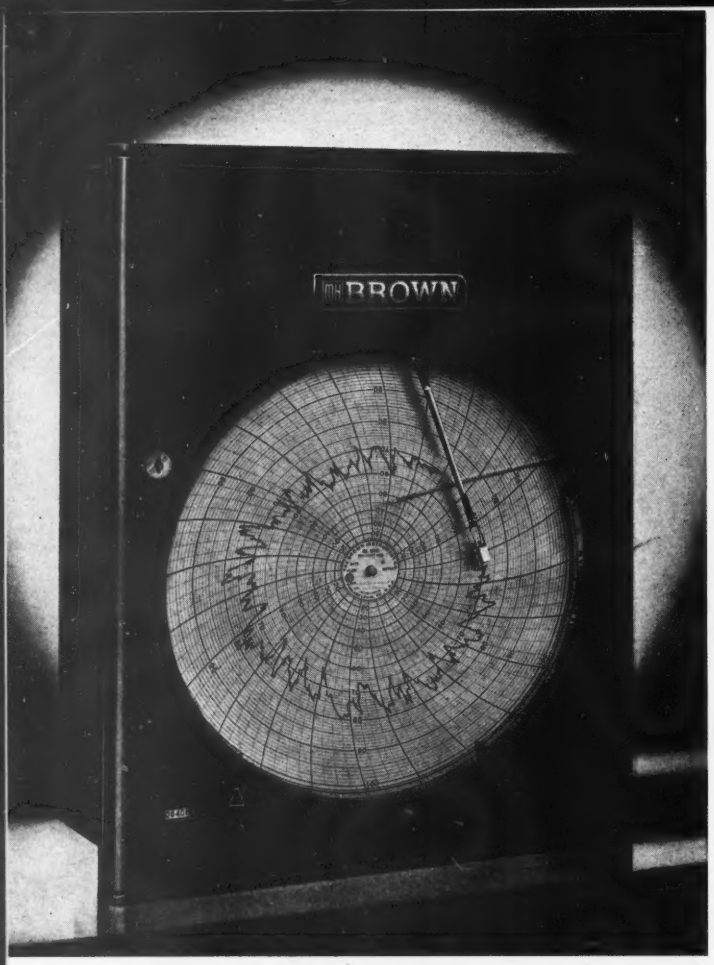
SMALLER CLEARANCES of the governor parts in modern turbines *demand* a turbine oil that will prevent *rust.* And because that same oil must adequately lubricate bearings, gears and flexible couplings to guard against costly shutdowns, it should also have *superior oxidation stability . . . minimum foaming tendencies.* The new Shell Turbo Oil is the first to meet *all 3* of these requirements.

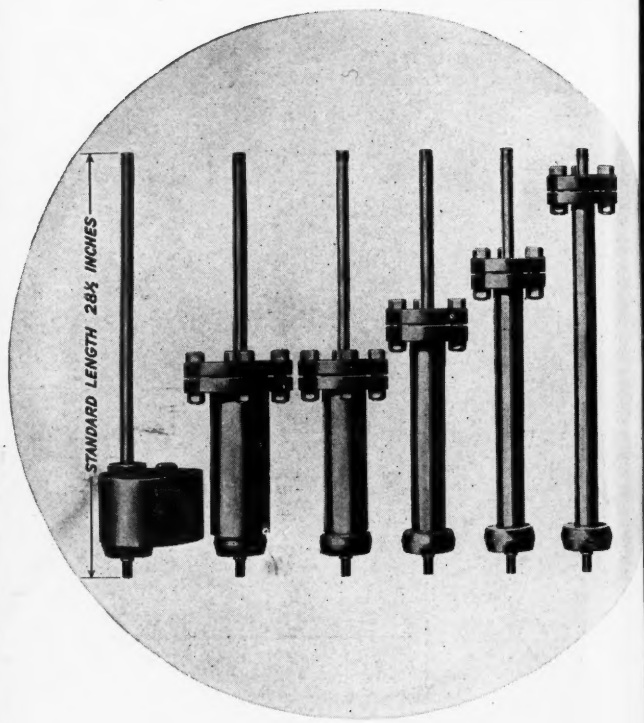
Call in the Shell man today and let him give you the *facts* about this revolutionary new turbine oil. You'll find his recommendations entirely practical—and made without obligation.

—with the turbine oil that prevents rust

SHELL TURBO OIL

SHELL





Range-Changing Easy, Quick, Inexpensive

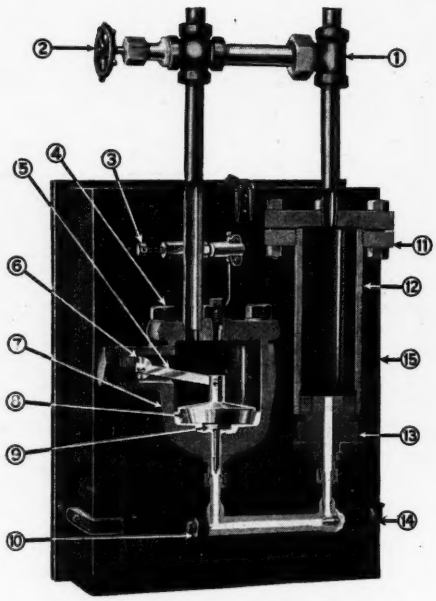
It is often necessary for plants to change the range of flow meters to meet different operating conditions. Users of Brown Flow Meters find such changes can be made quickly, easily and inexpensively by simply substituting a new range tube of the proper size.

If the original flow is found in error, as it is in many cases, or the average rate of flow changes, as it frequently does, the orifice need not be disturbed, nor another meter body installed to obtain the range required.

Seven interchangeable range tubes make it possible to get a four to one change in meter capacity in steps of roughly 25%.

In addition, other range tubes of 25-inch, 50-inch, 100-inch and 200-inch differential capacity are available.

Send for complete information. Write for Catalog No. 2204 describing many other advantages of Brown Flow Meters. THE BROWN INSTRUMENT COMPANY, 4491 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Amsterdam-C, Holland: Wijdesteeg 4—England: Wadsworth Road, Perivale, Middlesex—Stockholm, Sweden: Nybrokajen 7.



1. Valves and Piping. 2. Equalizing Valve. 3. Lubricator. 4. High-Tensile Strength Bolts. 5. Float Lever. 6. Pressure-Tight Bearing. 7. Meter Body. 8. Float. 9. Mercury Safety Seal. 10. "U" Tube. 11. Flanges. 12. Range Tube. 13. Range Tube Support. 14. Pulsation Check. 15. Rectangular Case.

BROWN Flow Meters

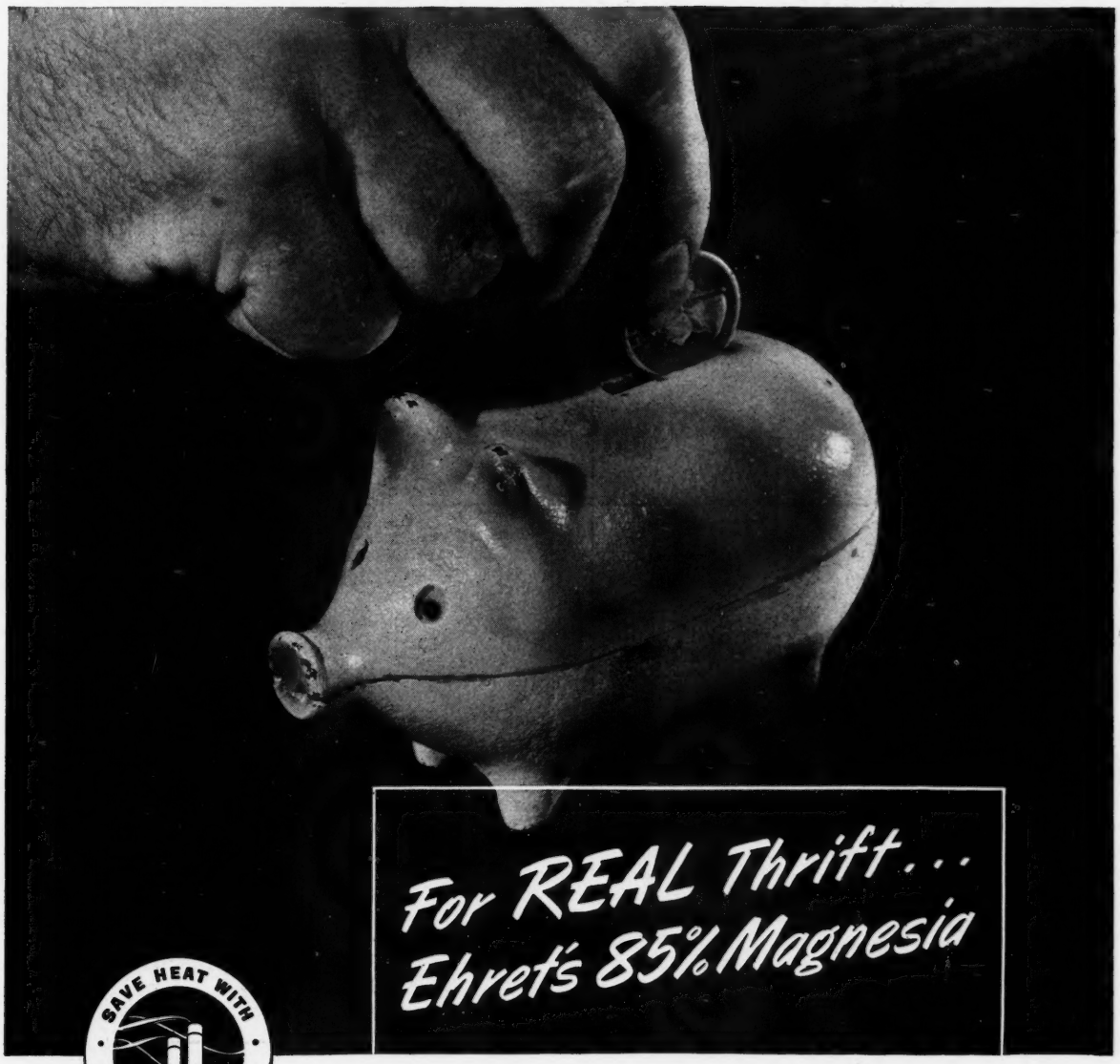
THE BROWN INSTRUMENT COMPANY, PHILADELPHIA, PENNSYLVANIA

DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

MINNEAPOLIS, MINNESOTA, AND 119 PETER STREET, TORONTO, CANADA

TO MEASURE AND CONTROL IS TO ECONOMIZE

Insulation Facts · Number 6.



SAVE HEAT WITH EHRET INSULATIONS

Because of its many advantages, Ehret's 85% Magnesia Insulation provides really substantial savings. Economy of plant operation in the form of fuel saved, together with low overall cost per year of the insulation itself, add up to savings that appeal to the users of this time-tested insulating material.

In addition to 85% Magnesia, the Ehret Company provides a full line of industrial insulations. There is an Ehret Contractor or Distributor in every principal city.

EHRET MAGNESIA MANUFACTURING CO.

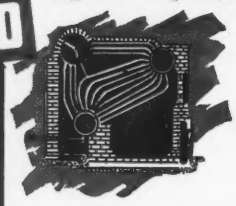
VALLEY FORGE · PENNSYLVANIA

MAKERS OF INDUSTRIAL INSULATIONS FOR MORE THAN 40 YEARS

STILL MORE IMPRESSIVE TODAY!

6 VERY IMPRESSIVE FACTS

~~12,814,000~~ 18,221,000 lb. per hr.



Steam Generated

~~800,000~~ 1,102,500

K.W. per hr. (High Pressure Units Only) Capacity

900°F. to 950°F.

Temperature Conditions

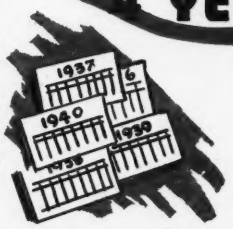
~~1240~~ to 2200 lb. 720

Pressure Range

~~18~~ 20 CONTRACTS

Awarded

~~4~~ 5 YEARS



1936 to 1940

The Figures given above show the confidence placed by consulting engineers, central station and industrial plant engineers and operators in this organization's ability to design, prefabricate and erect piping, regardless of the size of the job. The Kellogg Company has also prefabricated and erected many piping jobs ranging from 200 pounds pressure up.

Call in this organization the next time you have a piping project.

AD APPEARED Dec. 1940

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, N. Y.

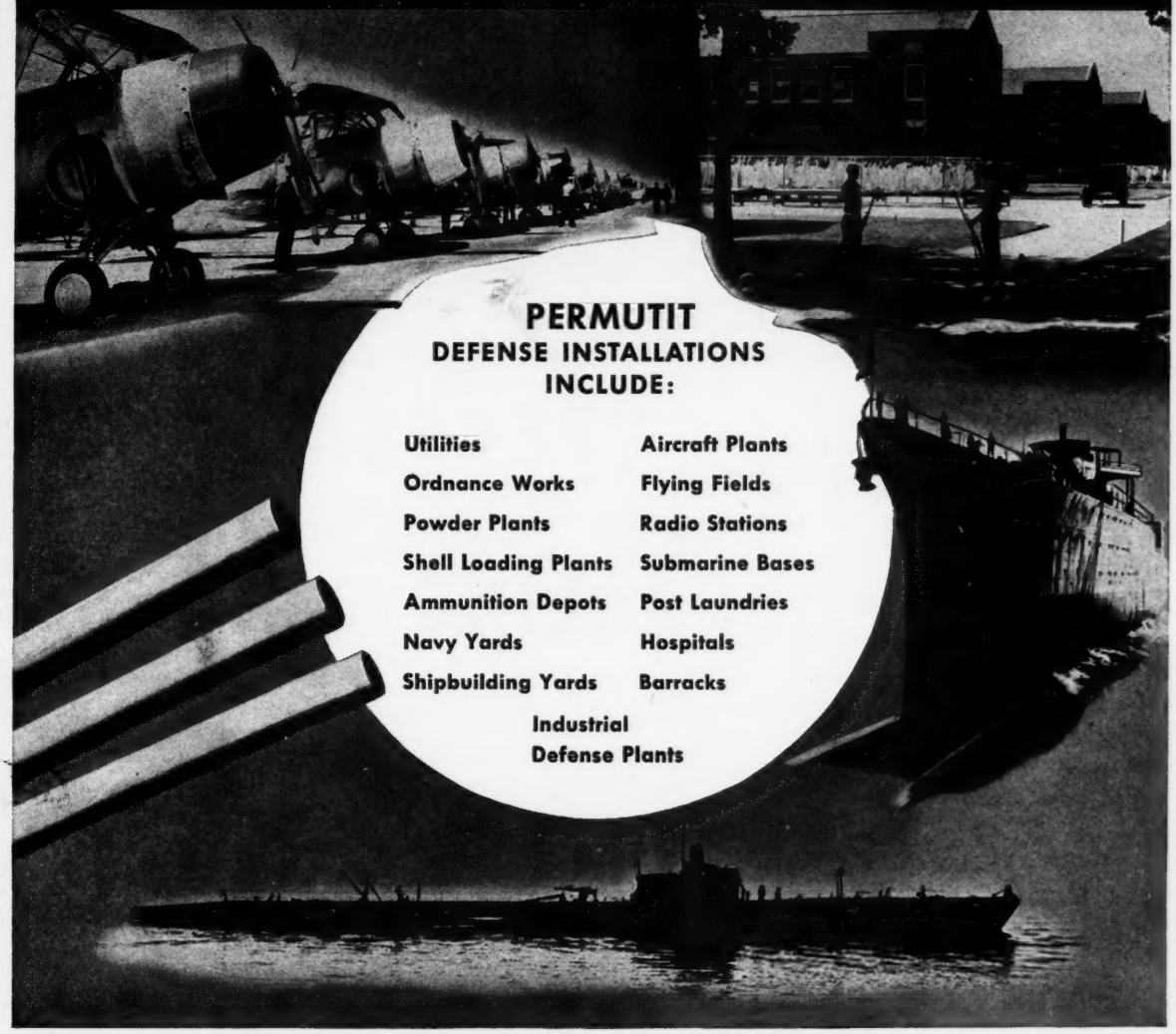
REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND · TULSA: PHILTOWER BLDG.

KELLOGG

"MasterFlex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

Water conditioning by PERMUTIT* . . . a defense necessity, too!



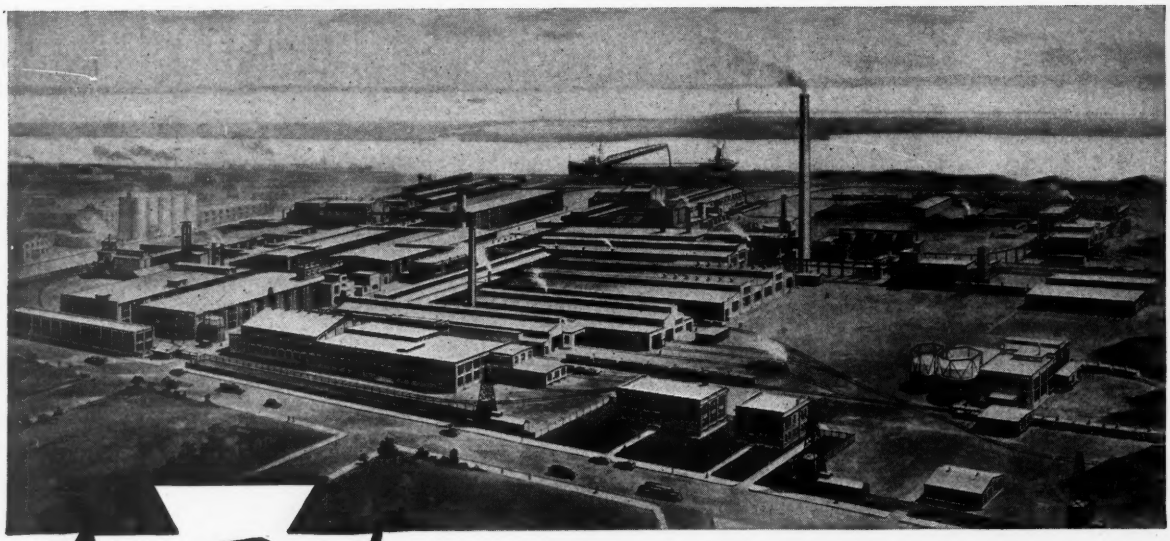
Permutit feedwater treatment keeps boilers operating without shutdown . . . prevents losses not only in boiler time, but in generator or prime mover output. Today more than ever—under the strain of increased production—power plants rely upon Permutit for continuous operation at maximum efficiency.

Permutit makes every type of water conditioning equipment . . . prescribes treatment that exactly fits individual plant needs.

• • •

FREE ADVISORY SERVICE—Bring your water problem to Permutit for expert help. Write for free booklets: The Permutit Company, Dept. A1, 330 West 42d St., New York, N.Y. *Trademark Reg. U. S. Pat. Off.

PERMUTIT WATER CONDITIONING HEADQUARTERS



REG. U.S. PAT. OFF.

"PENNSALT"

another industrial leader using

DARLING VALVES

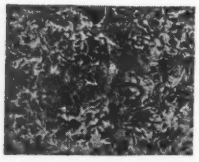
Pennsylvania Salt Company's big plant at Wyandotte, Mich., is another proving-ground where Darling *performance* is proved every day in the year!

As so many users have found, Darling valves perform better because they're made better. From the unique Darling design, with its smooth curves and uniform sections . . . through careful foundry technique, accurate molding, proper gating and heading . . . every manufacturing step aims at that smooth, close structure which we call "dense metal." Results: better machining, more accurate threading, and freedom from flaws or shrink. Three good reasons, we believe, why you'll be wise to specify Darlings in your next valve installation!

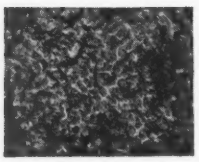
DARLING VALVE AND MANUFACTURING CO.
Williamsport, Pa.

Representatives in

New York Philadelphia Houston Toledo Pittsburgh
Chicago Huntington, W. Va. Seattle McPherson, Kans. St. Louis



Photomicrograph (mag. 100x) showing the structure of a typical sample of cast iron as ordinarily produced. Note the entrained inclusions tending to break down the strength of the metal and produce leaks.



Shows the structure of Darling Dense Metal gray iron. In this dense, fine, homogeneous grain structure the shrinkage porosity has been minimized, with resu'tant pressure tightness, strength and better resistance to abrasion and corrosion.

ADDING A NEW TURBINE? SEE WHAT NONPAREIL WILL SAVE

●You start saving money as soon as you *plan* to use Nonpareil Turbine Oil—even before your turbine is installed. Here's why: Nonpareil is *guaranteed* against acidity formation. That means very little equipment is needed to keep Nonpareil *as good as new* for the life of your turbine. A simple filter is all that is required to remove any foreign matter that might enter the oil system.

Thus you save the cost of installing batch treating or settling tanks, pumps, centrifuges, complicated filtering systems, and all the pipes and fittings and even the building space that is needed to house this equipment.

This saving on installation frequently more than pays the difference in cost between a conventional turbine oil and the first fill of Nonpareil. And remember, except for a small amount of make-up oil, the *first fill* of Nonpareil will *last as long as the turbine.*

Let a Standard Oil Engineer tell you why and answer any questions you have. Call the nearest local Standard Oil Company (Indiana) office, or write 910 South Michigan Ave., Chicago, Illinois. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

Copr. 1941, Standard Oil Company (Indiana)

NONPAREIL TURBINE OIL

1. Stability Against Oxidation and Sludge.
2. Non-Corrosive. 3. Good Demulsibility.
4. Proper Viscosity Grades.

STANDARD OIL COMPANY (INDIANA)

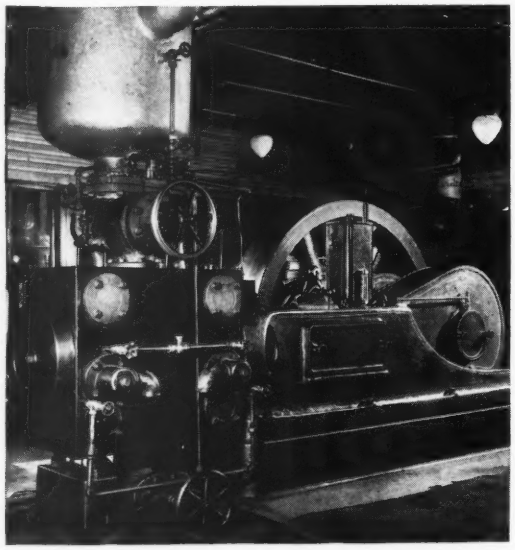
LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICAT

LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION

STANOIL FOR COLD STARTS AND HOT RUNS IN BEARINGS AND GEAR CASES

Are there certain motor bearings in your plant in which there's a race between "warming up" and "burning out" each time they're started in cold weather? Do you have reduction gears that must be heated before it's safe to turn them over . . . all because it's necessary to keep a high viscosity oil in them to withstand high operating temperatures?

Then, Stanoil is just what you need. It has high V. I. That means that it thins out less at high temperatures and flows easily at low temperatures. It has an unusually low pour test, too. Discuss one of your cold weather starting problems with a Standard Oil Engineer. He'll recommend the grade of Stanoil you need and help you test it.



SAVES 2 QUARTS OF OIL OUT OF 3, EVERY 8-HOUR DAY

Two things bothered the Minnesota operator of this Corliss type engine above. It had a big appetite for oil—3 quarts or more a day—and much of the oil was carried over into the exhaust steam where it was troublesome when the steam was used for heating.

By cutting down oil consumption he could reduce the carryover. But would the engine get adequate lubrication? The operator decided that he could use the help of a Standard Oil Engineer on that question. The Engineer analyzed operating conditions and made his recommendations. With the cylinder oil he suggested, engine feeds could be reduced. Then they waited for oil to show up in the exhaust steam. None appeared. Finally oil feeds were cut down to one pint per 8-hour day, with adequate lubrication and no carryover trouble.

Standard Oil offers the widest range of steam cylinder lubricants available to operators in the Middle West. Call your Standard Oil Engineer at the first sign of engine lubricating trouble.

FROM 3 BEARING FAILURES IN 6 MONTHS, TO NONE IN 2 YEARS

SUPERLA GREASE

The superintendent in a Minnesota mill reasoned that one bearing failure might be just an accident . . . two bearing troubles in six months could be coincidence . . . but the third failure left no doubt—some changes had to be made!

The installation, bearing alignment, etc.—seemed all right. What about the lubricant? That problem was turned over to a Standard Oil Engineer. Since Superla Grease No. 2X—which the engineer recommended—has been used, there has not been one bearing failure. And that was over two years ago.

SAVE YOUR TIME AND YOUR COMPANY'S MONEY

Have you noticed, from examples on this page, how easy it is to solve many lubricating difficulties simply by giving a Standard Oil Engineer a chance to work with you on them? You save your time experimenting with various lubricants. You save on repairs and replacement costs for your company. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois for additional information on any of the products mentioned here, or for the Lubrication Engineering Service offered. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

COLORADO
Denver

ILLINOIS
Chicago
Decatur
Joliet
Peoria
Quincy

INDIANA
Evansville
Indianapolis
South Bend

IOWA
Davenport
Des Moines
Mason City

KANSAS
Wichita

MICHIGAN
Detroit
Grand Rapids
Saginaw

MINNESOTA
Duluth
Mankato
Minneapolis

MISSOURI
Kansas City
St. Louis
St. Joseph

MONTANA
Billings

NORTH DAKOTA
Fargo

SOUTH DAKOTA
Huron

WISCONSIN
Green Bay
La Crosse
Milwaukee

WYOMING
Cheyenne

Ordered for more than

2,000,000

boiler horsepower

No other steam-flow type feed water regulator has ever been accepted so widely, so quickly. You will find installations of the COPES Flowmatic Regulator now in service or on order:

★

In 35 states and one territory, and in 15 other countries on four of the five continents.

★

On B. & W., Badenhausen, Bigelow, Bros, C-E, Edge Moor, Erie City, Foster Wheeler, Freyn, Lasker, Riley, Springfield, Titusville, Union, Vogt, Wickes and ten other makes of boilers.

★

On boilers operating at pressures of from 80 to 1900 pounds gage.

★

On boilers having capacities from 15,000 to 650,000 lbs. per hour.

★

And 40 users have placed 67 repeat orders for COPES Flowmatics—the best known proof of performance.

To be specific . . . in little more than four years, the COPES Flowmatic Regulator has been ordered for 474 boilers with a total steaming capacity of 69,553,250 pounds per hour. And for good reason. The COPES Flowmatic gives remarkably close water level control . . . usually within plus-or-minus one inch . . . regardless of boiler design, pressure or load conditions. Yet the design is so mechanically simple, the construction so rugged, that no more than routine servicing is needed. For complete information on this two-element steam-flow type regulator, write for Bulletin 429.

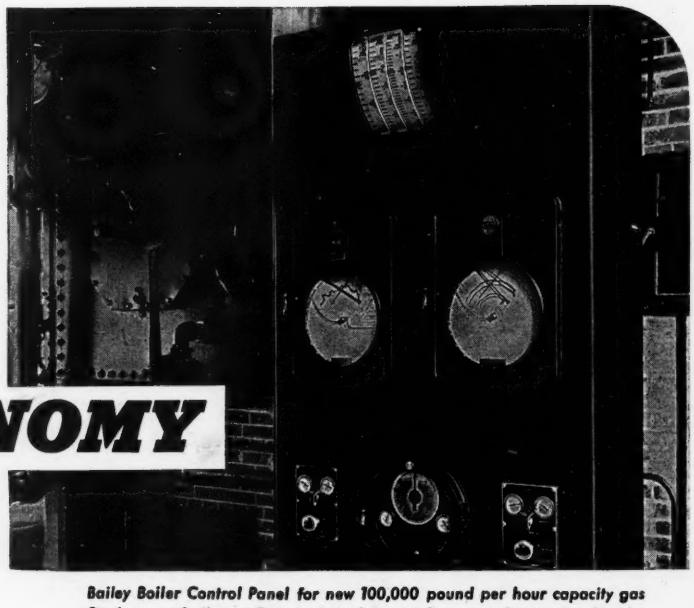
NORTHERN EQUIPMENT CO., 1212 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA AND ENGLAND REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC

FLORIDA MILL INSURES STEAM ECONOMY



Bailey Boiler Control Panel for new 100,000 pound per hour capacity gas fired power boiler at Florida Pulp & Paper Company, Pensacola, Florida.

Bailey Meter Control Continuously Secures Desired Steaming Capacity With Conservation of Fuel and Man Power

★ At Florida Pulp & Paper Company, Pensacola, Florida, boiler operators are provided with the best possible means of obtaining economy, safety and continuity of service. Here both the power boiler and the black liquor recovery unit are equipped with Bailey Meters and Bailey Meter Control.

The outstanding performance of Bailey Meter Control which enables operators to continuously secure ideal conditions is a result of the many outstanding features in the Bailey System. In addition to the usual control functions of maintaining steam pressure, regulating furnace draft and distributing load among boilers, Bailey Meter Control offers these plus values:

1. An automatic readjustment of the fuel—air ratio which functions continuously to insure economical combustion and safe furnace temperatures day after day.
2. No control system is better than its metering device—in the Bailey system control impulses are originated by standard Bailey Meters.
3. Provision is made for the protection of steam generating equipment by the addition of interlocks and detectors.
4. Experience, gained over the past 25 years in successfully controlling thousands of boilers by the Steam Flow — Air Flow principle, is built into each Bailey Control System.
5. Full-time Bailey Engineers who are thoroughly trained in problems of combustion and boiler operation, are stationed in some 30 conveniently located cities throughout the United States and Canada, where they are available to assist you in securing maximum performance from your boiler room equipment.

Bailey Meter Control which enables you to continuously obtain maximum economy, safety and reliability is described and illustrated in Bulletin 102-C. If you do not already have a copy ask for it now.

BAILEY METER COMPANY
1040 IVANHOE RD., CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada A-78

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

600 HORSES Flatten San Francisco's Hills!

26 Years of Motor Service . . . With never a Motor Failure! That's the Story of Two Allis-Chalmers 300-Horsepower Motors Operating San Francisco's Historic California Street Cable Car System!

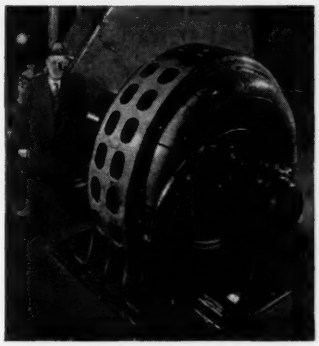
YOU GET a different kind of a street car ride in San Francisco . . .

As part of the picturesque background of this colorful city, cable cars climb hills that would balk ordinary trolley cars . . . grades as sharp as 21%! And down under the tracks are moving continuous cables . . . eleven miles of them . . . kept going at a steady pace of 8½ miles per hour by two Allis-Chalmers 300-hp Lo-Maintenance Motors located at the central station.

No Motor Failures in 26 Years

There's a fascinating story here. Built by Governor Leland Stanford in 1878 . . . destroyed in the earthquake and fire of 1906 . . . the California Street Cable Railroad occupies a unique place in municipal street transportation systems. But that's only part of it —

For the Allis-Chalmers Motors are doing a behind-the-scenes job that is equally interesting to every motor user. Providing power to operate 60,000 feet of underground cable . . . running an average of twenty hours a day . . . there's never been a motor failure with these motors since they were installed 26 years ago! Significantly, it's the same kind of dependable, long-life, low-cost service that Lo-Maintenance Motors have given in thousands of other industrial installations all over the country.



TWO ALLIS-CHALMERS 300-HORSEpower motors keep eleven miles of underground cable in steady motion 20 hours a day to operate the famous California Street cable cars. Shown here with one of the motors is 86-year old James W. Harris who recently retired as president of the company.

If this is the type of motor performance you want in your plant, get the facts about Lo-Maintenance Motors. The engineer in the district office near you will be glad to give you the information you want. Or you can write Allis-Chalmers, Milwaukee, Wisconsin.

A 1369

ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND UP

Uniformity, dependability, high quality... these are the features that make J-M Service Sheet the No. 1 Sheet Packing for industry

MORE AND MORE engineers are safeguarding gasket performance by switching to J-M Service Sheet. Basically asbestos, this tough material not only stands up longer, but is completely uniform, both in density and quality. Because it does not deteriorate with age, it can be kept in stock indefinitely.

If you're not already using J-M Service Sheet, it will pay you to investigate. And if you have any other packing problems, you'll find an efficient, economical solution in the balance of the complete J-M line. For details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM

Johns-Manville PACKINGS & GASKETS

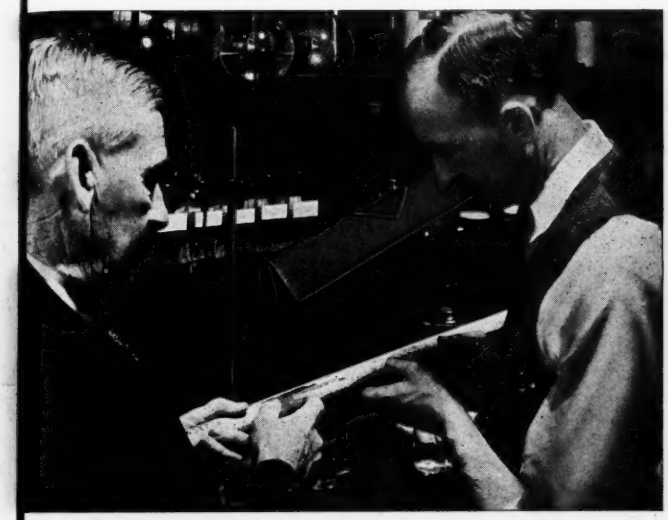
THERE'S A DISTRIBUTOR NEAR YOU

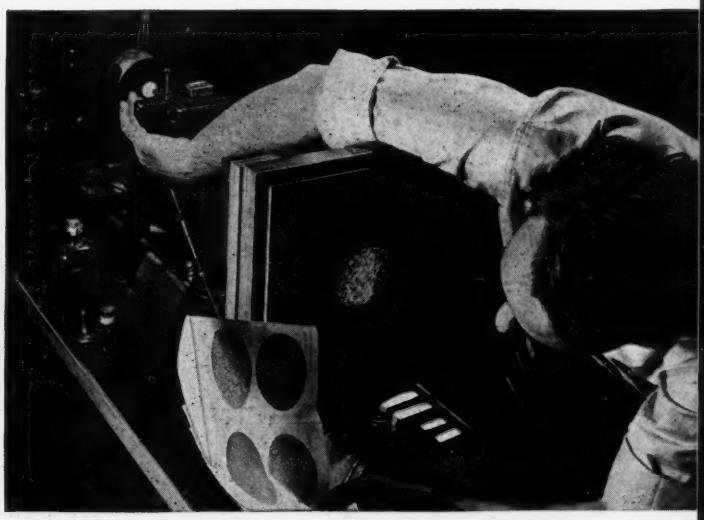
THE TUBE THAT REPAIRED ITSELF

AND DOUBLED ITS LIFE

Well-known is the ability of copper and its alloys to form, under the right conditions, protective films which can repair themselves when broken.

Analyzing such reactions — obtaining *the right metal for the job*—is part of the 3 services Scovill offers its customers: service in *men*, in laboratory-controlled *metals*, and in *manuals* for easy reference. Pictures on this page show these services in action.





Problem — Corroded tubes like this were costing a large oil refinery replacements every 8 months. A Scovill consultant, called in, found Admiralty tubes operating in vapor-side temperature, of 210°F., with a permeable scale formation favoring dezincification. Contaminated salt to brackish circulating water was used for cooling.

Now It's In This Booklet — Cases like this, covering all varieties of heat exchanger conditions, are the backbone of Scovill's "Condenser Tubes" booklet. Subsections devoted to the corrosion of metals and alloys... may include equally valuable cost-saving hints for *you* ... a copy of this booklet is available upon request. Address Scovill Manufacturing Company, 17 Mill Street, Waterbury, Connecticut.

Solution — Back to Scovill's laboratories went the facts and figures. "At 210°F., recommend 70-30 Cupro-Nickel," said the laboratory men. An inquiry later developed the fact that these tubes lasted 16 months without a failure — a 100% increase in service life.

Reason — the 70-30 Cupro-Nickel tubes had formed a protective film out of their own corrosion products, a film that repaired itself—thanks to Scovill's accurate analysis of the chemical reactions involved.

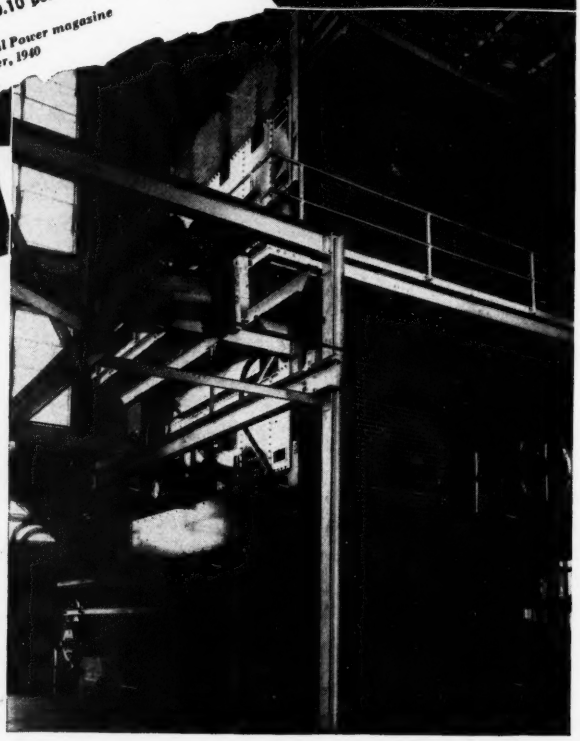
Modernization pays at the GRIESEDIECK WESTERN BREWERY, Belleville, Ill.

STEAM COSTS DOWN 27%

"Records of the old plant operations disclosed that in a given period 67,515,500 lbs. of steam were generated at a fuel cost of $9,313.58, or $0.138 per 1000 lbs. Over a comparable period, with the new boiler 72,550,050 lbs. of steam were generated at a fuel cost of $7,285.06, or approximately $0.10 per 1000 lbs."

from Industrial Power magazine November, 1940

Above—Boiler unit under erection.
At right—Boiler room view showing unit in service.



VOGT *Water Tube* BOILER reduces steam cost from $0.138 to $0.100 per 1000 lbs. of steam!

To meet increasing process steam demands occasioned by its expansion program, the Griesedieck Western Brewery, Belleville, Ill., replaced old boilers with the four-drum Vogt unit illustrated hereon.

Plant records reveal that this brewery now enjoys a 27 percent reduction in steam costs. The new unit has also demonstrated its ability to handle abrupt load changes of up to 10,000 pounds of steam per hour without carry-over of boiler water . . . of extreme importance in brewery process work.

Get Vogt's recommendation for *your* steam boiler requirements . . . without obligation. Our nearest office is ready to serve you!

PRINCIPAL DATA:

Unit has 6,140 sq. ft. of heating surface generating 40,600 pounds of steam per hour ★ Air cooled front and side setting walls ★ Water cooled bridge wall ★ 275 pounds per square inch design pressure ★ Fuel—Coal screenings.

Bent Tube, Sectional Header and Box Header Type Boilers for any fuel!

Vogt WATER TUBE BOILERS

HENRY VOGT MACHINE CO., Inc. LOUISVILLE, KY.

Branch Offices: New York Philadelphia Cleveland Chicago Cincinnati St. Louis Dallas

Specify "SPLIT-GLAND" Columns for Your Next Project

. . Most Important of the Boiler Attachments is the Water Gage

FIG. 1 illustrates "Split-Gland" Inclined High and Low Alarm Column for steam working pressures up to 300 lb.

★Ernst improved DUO-COLOR illuminator gives a bright RED reflection of the water level in the glass without any special Red-Line gage glass. Can be seen on boiler room floor with aid of Mirror Stand.

NO GAGE GLASS PACKING NUTS

ADVANTAGES INCLUDE:

- Simple and Easy to install a Gage Glass FLAT, ROUND or REFLEX TYPE. No wrenches or tools required to do this.
- Unobstructed clear view of the water level.
- Gage Glasses can be set at any desired angle, or vertical.
- Upper and Lower Valves are interchangeable, therefore—Gage Glasses can be set to the right or left of valve bodies.
- "Straight through" passageways facilitate cleaning.
- No Valves or "Dirt Traps" between Shut-off Valves and Column.
- Adjustable for perfect alignment of Gage Glasses, hence no breakage due to misalignment.
- Extra deep Packing Spaces insure against leakage.
- The "off-set" feature also provides for illumination directly from rear of glasses if desirable.
- Made for pressures up to 2000 lbs.

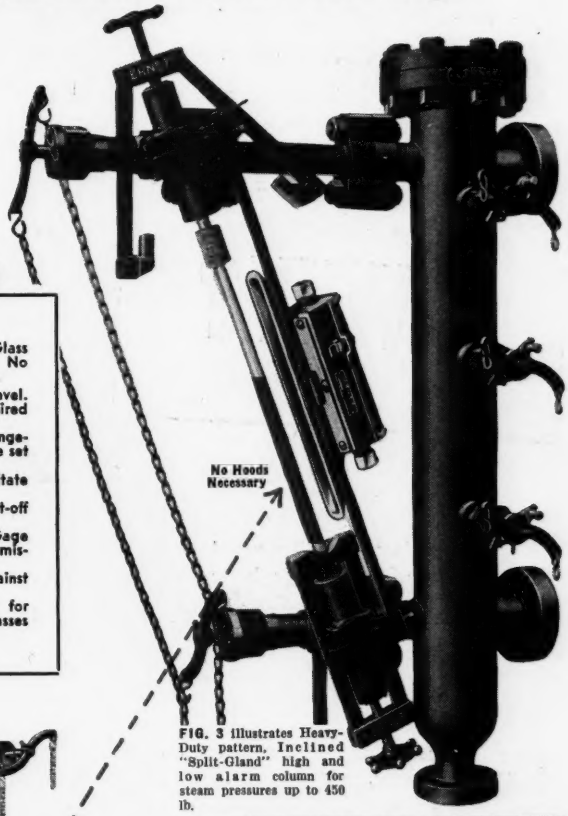


FIG. 3 illustrates Heavy-Duty pattern, Inclined "Split-Gland" high and low alarm column for steam pressures up to 450 lb.

FIG. 2 illustrates "Split-Gland" Vertical high and low alarm column for pressures up to 350 lb.

FIG. 72 illustrates "Split-Gland" Column with "C-Clear Thru" Flat Glass Insert, for working pressures ranging up to 1500 lb.

FIG. M2

COMPLETE

Water Column Equipment

How to specify

Each Boiler to be furnished with Ernst Split-Gland Water Columns suitable for — pounds working pressure. Equipment consisting of Column, Split-Gland Adjustable Water Gage Fittings and Leakless Super Try Cocks. Gage Glass Guards and Illuminators are to be furnished, and sufficient rust-proof Chain to operate Gages and Try Cocks from boiler room floor.

All material as manufactured by Ernst Water Column & Gage Co. Livingston, N. J.

OTHER ERNST SPECIALTIES

- Water Columns, Forged Steel
- High and Low Alarm Columns
- Bronze Vertical Water Gages
- Forged Steel Water Gages
- All Iron Gages
- "C-Black" Reflex Inserts
- "C-Clear Thru" Flat Glass Inserts
- Leakless Super Try Cocks
- Spring Type Try Cocks
- DCP Weighted Type Try Cocks
- Forged Steel "Leakless" Try Cocks
- Round-Tubular gage glasses, clear or red-line type
- Clear and Reflex glasses with gaskets
- Series 750, Composition gage glass gaskets
- Illuminators, Plain Sight

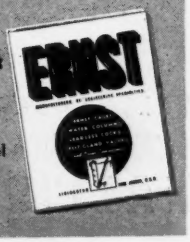
Send for Catalog No. 45 Describing the above

ERNST WATER COLUMN & GAGE COMPANY

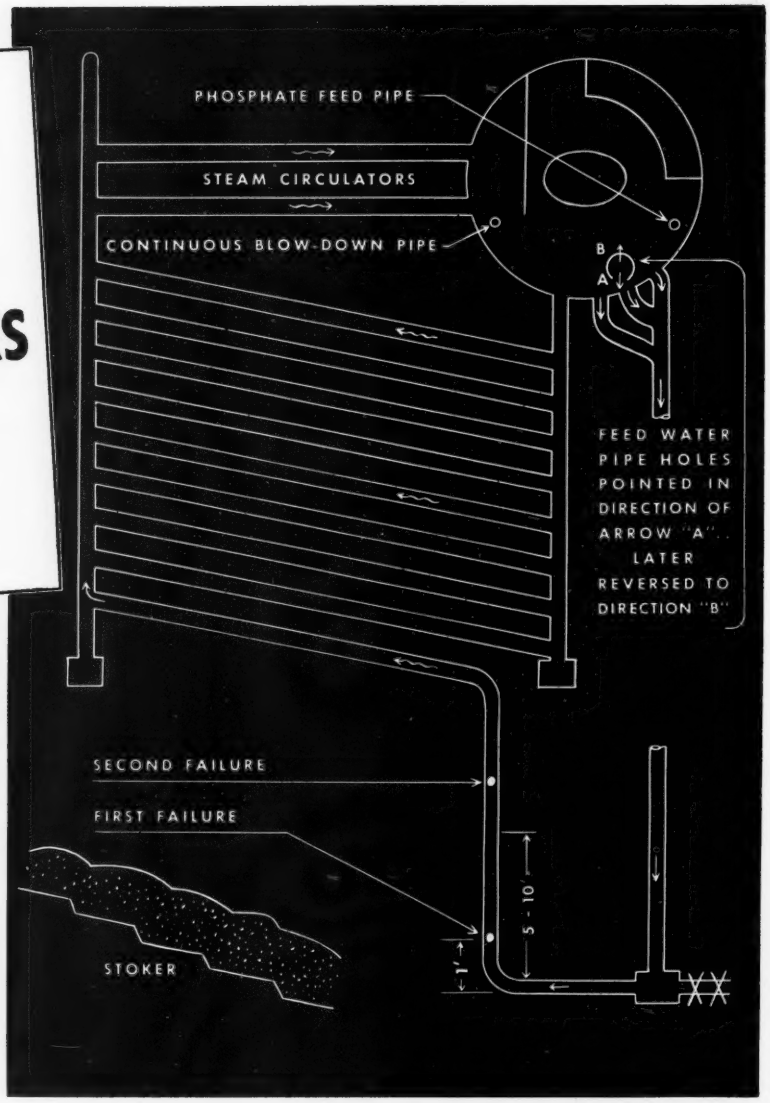
LIVINGSTON, N. J.

Representatives in Principal Cities

See our ad in A.S.M.E. 1942 Directory, Page 96



NEW BOILER BURNS OUT TWICE IN 6 WEEKS ...WHY?



WHY should a new boiler rated at 65,000 lbs. of steam per hour and 420 lbs. pressure burn out 4 tubes low down in the rear water wall during the first month? First thought—maybe it was too frequent blowdown of the rear water wall.

Then why, after locking the blowdown connections and welding in new tube sections, should seven tubes fail higher up within just two weeks of operation?

Was it caused by untreated water reaching the affected tubes? The plant staff didn't think so. Their tests showed nothing wrong. The boiler drum and visible tubes were clean as a whistle.

Having done what they could, they sent for a Hall Service Engineer. His examination showed no unusual conditions in tubes or drum. The boiler was in excellent shape. Then a section of one of the bagged tubes was cut out. In this was found an extremely thin, brittle coating of a grayish crystalline scale. Analysis showed largely calcium sulphate and a small amount of calcium carbonate. That could mean only one thing — untreated water *was* reaching the affected tubes. But how?

He inspected the drum again. This time he noted that the holes in the boiler feed pipe were directed downward. If untreated feed water was reaching the tubes, this was a way it could do it.

Then he checked the boiler blueprints. Sure enough, the feed holes should have been directed upward. Here was the needle in the haystack. He rotated the pipe 180°. That was months ago. There has been no more trouble with burnt out tubes.

There you have another of the thousands of cases where a Hall Engineer working with the plant staff keeps boilers on the line, another proof of the value of expert engineering knowledge in connection with water conditioning service.

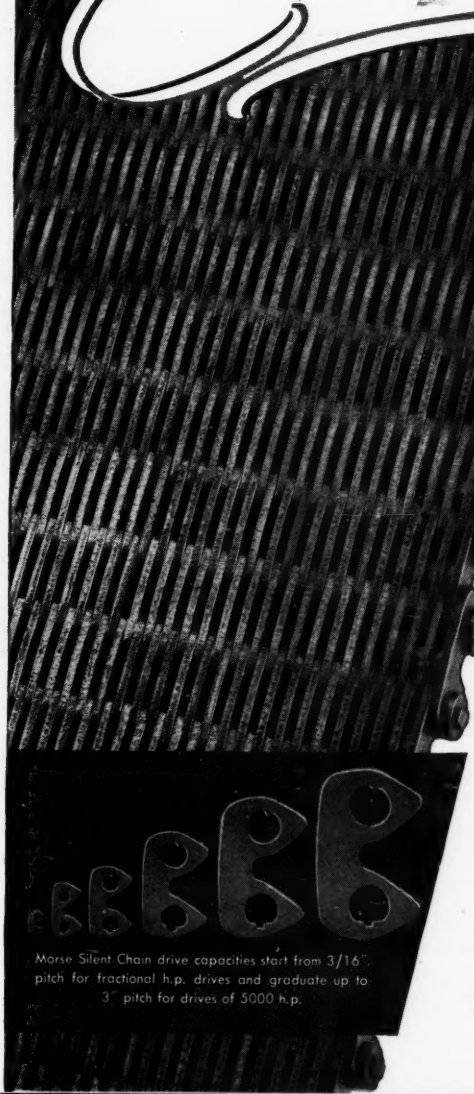
Never has a protective boiler water conditioning service of this kind meant more to you than now. Why not ask us to explain it to you?

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

HALL SYSTEM *of Boiler Water Conditioning*

There is a **MORSE CHAIN DRIVE**

TO MEET YOUR REQUIREMENTS



Morse Silent Chain drive capacities start from 3/16" pitch for fractional h.p. drives and graduate up to 3" pitch for drives of 5000 h.p.

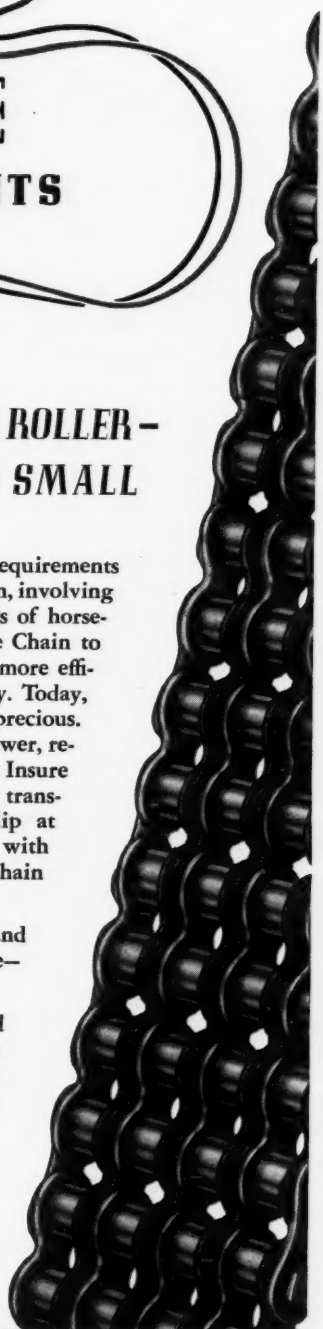
SILENT OR ROLLER— LARGE OR SMALL

Whether your drive requirements be silent or roller chain, involving fractional or thousands of horsepower—there's a Morse Chain to fill your specific needs more efficiently and economically. Today, power for production is precious. Inefficient drives waste power, reduce machine production. Insure against such "sabotage" by transmitting power without slip at constant (99.4%) efficiency with Morse Silent and Roller Chain Drives.

Morse Silent Chain speed and length changes are easily made—no need to dismantle machine.

Morse Roller Chains with solid rollers are interchangeable with all other standard round pin roller chains—available in single and multiple widths.

Learn how you can use Morse Silent and Roller Chain Drives to advantage—consult the Morse man in your territory.

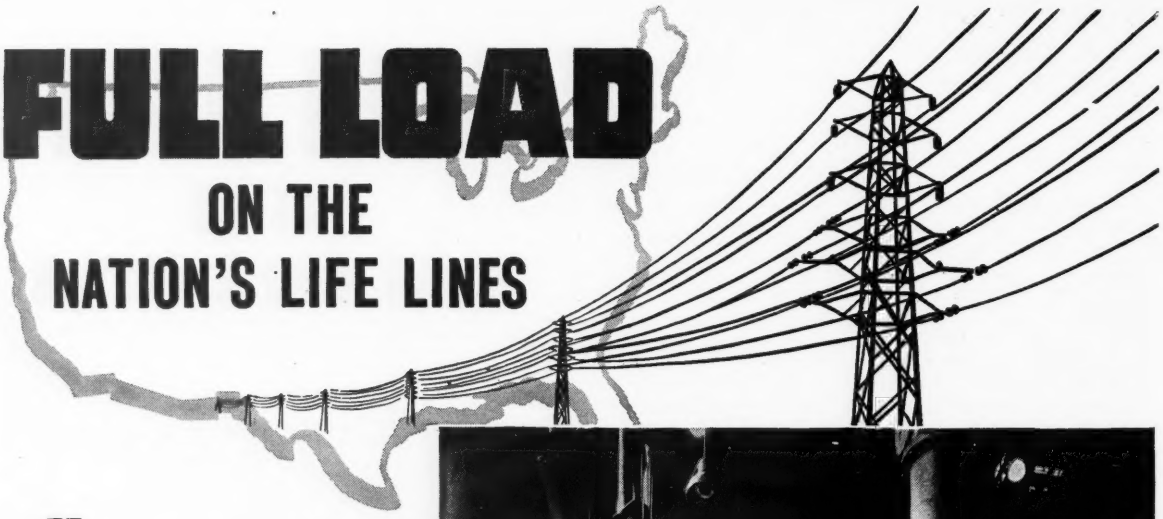


SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

FULL LOAD
ON THE NATION'S LIFE LINES



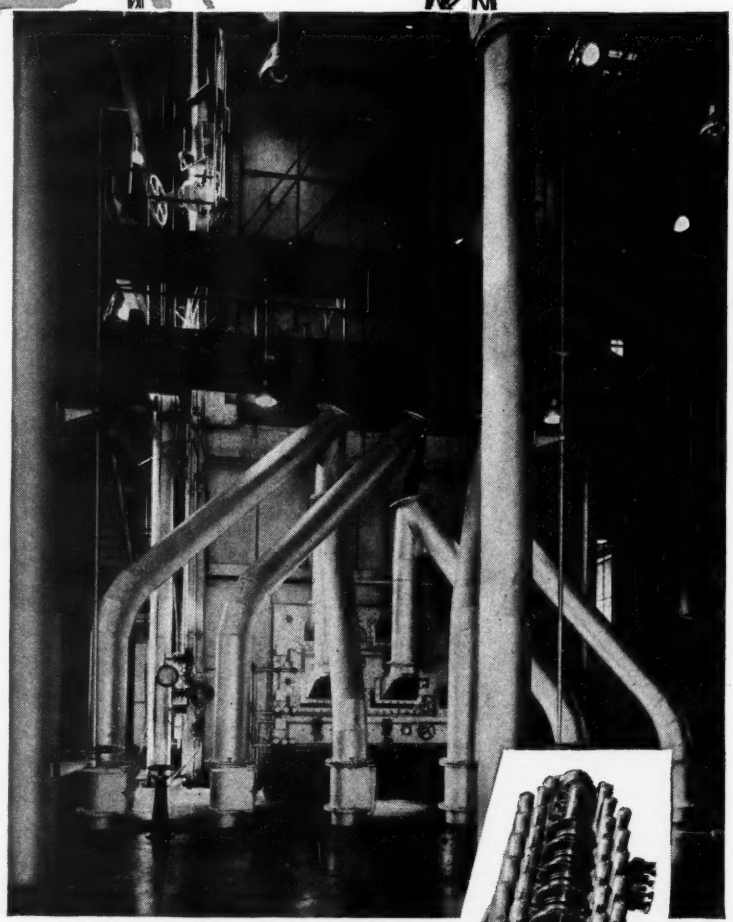
High overhead run the nation's life lines... gleaming carriers of power. Today they carry the heaviest load in history. For without power there can be no production... every plane, tank and gun that comes out of American factories tells a success story of the Power Industry.

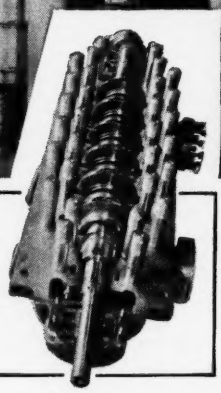
Years before the shadow darkened the world, this great industry was devoting time and energy to achieving an ever higher load capacity. Stronger boilers were built to generate higher steam pressures. Equipment was improved to wrest more energy from less fuel. Even before Defense production hit its stride, power produced in the United States reached the record figure of one hundred and forty-five billion kilowatt hours.

Throughout the years one of power's staunchest allies has been INCO Nickel Alloys. Stepped-up production calls for materials that are hard, tough, strong and resistant to heat, corrosion and erosion. Monel, "K" Monel, "S" Monel and the rest of the Nickel alloy family meet these requirements.

In the power industry as in scores of others they are an integral part of the Defense Program.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.





One of 6 Allis-Chalmers six-stage "Doubleton" boiler feed pumps installed at the Millers Ford Station of the Dayton Power and Light Company, shown with cover removed. Each is equipped with 6 impellers of cast Monel. Operating at 3730 r.p.m. against a pressure of 1500 lbs. per square inch, each discharges 415,000 lbs. of 250° F. feed water per hour.

In recognition of outstanding achievement in producing for National Defense, the Navy Ordnance Award was presented to the Huntington Works of The International Nickel Company, Inc., on August 13, 1941.

INCO NICKEL ALLOYS

MONEL ★ "K" MONEL ★ "S" MONEL ★ "R" MONEL ★ "KR" MONEL
INCONEL ★ NICKEL ★ "Z" NICKEL

SHEET . . . STRIP . . . ROD . . . TUBING . . . WIRE . . . CASTINGS

Again! DETROIT STOKERS SCORE HIGH

THE LUZERNE RUBBER COMPANY
MANUFACTURERS
HARD RUBBER GOODS
MAIN OFFICE AND FACTORY
TRENTON, N. J.

October 7, 1941

Detroit Stoker Company
General Motors Building
Detroit, Michigan

Gentlemen:

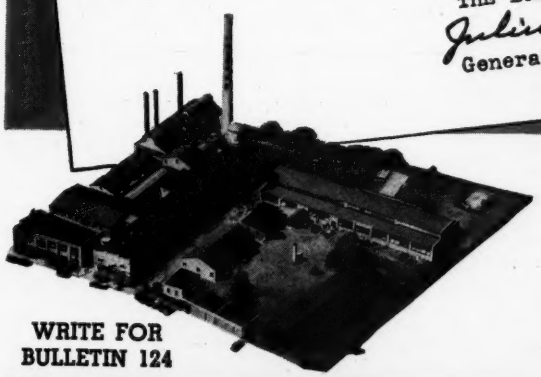
We are as well pleased with this equipment as we were when we installed our first Detroit Multiple Retort Stoker in 1935.

Savings in fuel over our previous methods of producing steam have justified the investment. We are able to carry our entire load with little, if any, change in steam pressure, in spite of sudden changes in load.

This uniform steam pressure has enabled us to increase our production and eliminate a great deal of spoilage previously encountered.

Very truly yours,

THE LUZERNE RUBBER COMPANY
Julius Phillips
General Manager



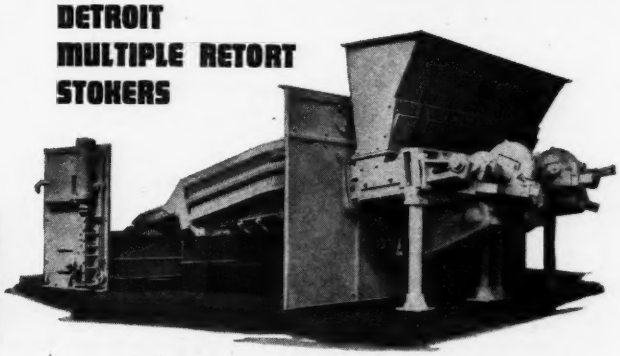
WRITE FOR BULLETIN 124

DETROIT STOKER COMPANY

Sales & Engineering Offices
General Motors Building
Detroit, Michigan

Main Office and Works
Monroe, Michigan
Built in Canada at London, Ont.

DETROIT MULTIPLE RETORT STOKERS



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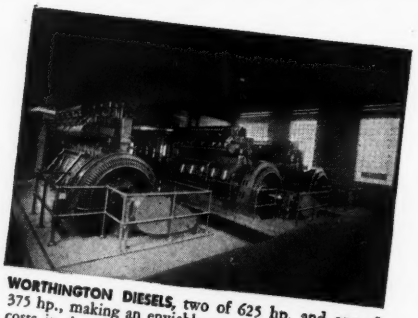
FREE IN ITS GROOVE



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DECEMBER, 1941
VOLUME 45, No. 12

Cover: Milk bottles passing through motor-driven electrically-heated hooding machine. Panel at left controls vacuum bottle filler, hooder and conveyor. Photo courtesy Bowman Dairy Co.

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128 YARWAY IMPULSE TRAPS
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WINTERS are really cold in Woodland, Maine, up on the Canadian border, but Yarway Impulse Traps handle the heavy condensate load with dispatch at the St. Croix Paper Company Plant. 128 Yarway Impulse Traps are in use at this plant — draining unit heaters, air preheaters, steam mains and other equipment.

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YARWAY IMPULSE STEAM TRAP

CAN U. S. PLANTS BE BOMBED?

EASY! Says GEORGE R. HUTCHINSON

BOMBING is causing a lot of destruction, but alone it is not going to end any war. I have never seen a man, woman or child in England cry, although I was there, December 29, 1940 the night of one of the worst air raids. There were 63 people killed when a bomb struck the Hotel Adelphi where I was staying, and I was knocked out of the bathtub. Yet, on going outside the next morning, everyone was busying cleaning up the debris with never a sign of fear.

In spite of failure in this direction, however, the airplane definitely involves a potential threat through interruption of industrial production by bombing and from parachute troops. The effectiveness of the latter was demonstrated recently in England when an American general took over a British airport with 20 men, dropping these 20 men from parachutes. At the airport at the time 500 or 600 soldiers were spread fanlike all over the place. This feat, which is not publicity, nor propaganda, but a simple statement of fact, was accomplished in a sham battle and astonished high ranking army officials.

But how does this threaten the United States? After 14 yr. in aviation, flying in 51 countries, flying ships across the ocean for the last year and seeing only one fatal accident, I find that with the aid of celestial and radio navigation, flying today is perfectly safe. Crossing the Atlantic has become quite a routine affair with ships running less than 50 per cent power, and with a load that could be increased 100 per cent and still get them over and back with no difficulty. One can safely say, and prove it any number of ways, that a 12 hr. flight between New York and London today is a very simple accomplishment in either direction. We have made faster time, as far as the record is concerned, from east to west.

A ship comparable with one of the modern transports can carry about 40 men, each with, say 500 shells, two pistols, and maybe two or three hand grenades. Under maximum load the plane comes over from France, Holland or Germany, or for that matter from any base in Africa, Russia or even South America, and flies across the ocean at 20,000 or 25,000 ft. When near his objective the pilot cuts his engine and glides down.

I don't think you can pick up idling engines gliding earthward at that altitude with a sound detector and in the United States we have very few anti-aircraft guns. Even where the anti-aircraft are numerous, they don't bring down very many planes. England is bringing down about one-eighth of one per cent of the ships they fire at. They are only an aid to keep attacking bombers at high levels.

But these ships come over, say in a serious attempt, 500 of them in a mass flight. With 40 men each, they glide down, and at a given time all these men, 40 × 500 or 20,000 trained troops, begin to jump, in black parachutes. Remember this would be in darkness and never on a moonlight night. Suppose these 20,000 parachutists land, determined to take any given area. Can you show me how you can get these men out without destroying your own city and your own people? Any well-equipped, properly armed soldier will kill 10, 20 or 100 men before he is killed.

Around New York, you have La Guardia, Floyd Bennett and Mitchell Air Fields. Enough men can be landed by parachute to hold those airports, or even one of them, until these transport planes can land, be refueled, take off for the other side again. On the other hand, suppose the enemy didn't want to get those ships back, or save them, what would they do? They could sacrifice them, but in so losing them, they would have destroyed ten or a hundred times as much in comparison through death and property damage.

But aside from this possibility I suppose you would like to know whether or not the United States could be bombed today! In my opinion the U. S. can easily be bombed today. Of course, you and I know that they are not going to bomb New York, and they are not going to bomb Philadelphia. If they bomb any place, it would be Detroit and Buffalo.

Why? If you strike out the Detroit Edison Co. tomorrow, all the important defense work in that area would be stopped immediately, because practically all the electrification of Detroit comes through the Detroit Edison Co. By taking Buffalo, or bombing the electric power plants of the Niagara Falls, you would practically hold up all the defense work in all of Ontario, Canada. Strike out Detroit, Buffalo, Pittsburgh and Cleveland and believe me the defense work in the U. S. will be well-nigh crippled.

If this is a 6 or 10 yr. war, we are going to have a much greater part in it than we have even today, and we must take a constructive point of view regarding some things to protect our most vulnerable cities. The two most vulnerable areas are Buffalo and Detroit. I think those two places should be covered, even today, by a balloon barrage.

A balloon barrage should be put up around Detroit within a 100 mi. area, and I think every plane flying over and around Detroit should have an identification number, to be given to an office at a specified base, so that that ship can be identified when it gets within the 100 mi. protected area. When a ship is not identified, find out immediately what it is doing in that area. It would be simple for a man friendly to Germany to put considerable TNT in a little Taylor Cub, and take it over and drop it on Detroit. We must have some control over every plane flying over defense producing areas!

GEORGE R. HUTCHINSON, Lieutenant Colonel, by grace of the Governor of Texas and not of Uncle Sam, as he points out to keep the record straight, has many claims to distinction. Considering present conditions perhaps the most timely of these is that he was the first pilot accepted to ferry bombers across the Atlantic.

Back of that was over half a million miles of flying over the world—not as a lone eagle but as father and head of the Flying Hutchinsons (4) which as a family group has flown in 50 different countries all over the world and who regard a plane much as a cowboy does a horse.

Colonel Hutchinson is not an engineer, but an aviator who appreciates the fact that indiscriminate bombing as an instrument of terror accomplishes little, but that accurate bombing of industrial objectives can be tremendously effective in stopping production. In a highly industrialized area, power plants are the focal point—highly vulnerable to invader bombing planes, parachute troops or even individuals in private planes not under adequate control and supervision. Say Alarmist if you wish, but that's what the Colonel told the Executive Club of Chicago and it made a plausible tale. Colonel Hutchinson knows from experience that raids today are possible—conditions are shaping up so that in a few weeks they may well be probable.

Photo, Courtesy Fafnir Bearing Co.

Power Driven Windmills

AMONG the many curious contrivances emerging from National Defense work are these four "wind wagons" as they are called. Simple enough in principle, they nevertheless represent a distinct advance in the training of glider pilots. By means of these devices, man is enabled for the first time to fly on a man-made wind by generating an artificial wind these machines permit the neophyte to get the "feel" of the glider's controls before he ever cuts loose from the towline and ventures aloft on his own. He takes his place at the controls of his craft which is held in position in front of the wind wagons by two long cables. As the blast begins, his glider can rise like a kite, up to 10 ft. from the ground, just as he wills. He learns to keep his nose on the horizon, to control the lateral balance of the ship with the ailerons, and finally, just how much forward pressure is needed on the stick to "land." ¶ The propellers of these wind wagons are 7 ft. in diameter, are mounted on shafts belt-driven from the main drive shaft of each auto chassis and powered by regular automobile engines. Needless to say, when these propellers turn up at a speed necessary to produce a 50 mile per hr. gale there is plenty of load on the bearings. The shafts are carried on two Fafnir ball-bearing pillow blocks capable of sustaining not only a high radial load but high thrust capacity as well. ¶ This rather unusual application of power, aside from its inherent novelty, emphasizes how thoroughly mechanical power is woven into the fabric of our entire civilization. Even in the use of the glider, which is a non-power type of aircraft, we find it desirable to introduce a form of mechanical power, if only for training purposes.

WITH THE EDITORS

◆ **MAINTENANCE — A PATRIOTIC DUTY** . . . Every effort possible is being made today by those who produce power to meet satisfactorily all the demands placed upon the power generating equipment of the country by the Defense Program being carried out by Government officials. The greatest burden, of course, falls on the public utilities and these as a rule are keeping ahead of demands by adding new equipment as rapidly as this equipment can be secured and construction work completed. Industrials, however, have been slower in providing for power expansion and many of them are now facing shortages that will be difficult to meet. As might have been expected, materials that are used largely in the manufacture of munitions are now being rationed out to manufacturers as Government authorities can be convinced of their need.

Although there are but few factories that are not today making war products or those that fit somewhere into the Defense Program, manufacturers of power equipment have no choice but to make deliveries according to Government instructions. The burden of proof of need falls upon the customer who is compelled to plead his case before the Office of Production Management. All this means delay and in the meantime the plant equipment, running at full capacity and, in many cases, without the opportunity to make replacements, repairs or carry on maintenance work as it should be done, is deteriorating more rapidly than it should under normal circumstances. Under such conditions the danger of forced shutdowns or even breakdowns is imminent, and it is the wise engineer who puts more emphasis on maintenance work during overloaded conditions than when spare units are available.

New equipment may be on order or even in the course of erection, but the old equipment in an overloaded plant needs extra special care as long as spare units are not available at all times.

◆ **REPAIR PARTS** . . . Fortunately Government authorities have, from the beginning of our present emergency, recognized the importance of supplying power to industries engaged in the manufacture of munitions and likewise the need for maintaining power equipment in all plants in working condition, for they realize that as equipment becomes inoperative new units will be ordered placing a further burden on manufacturers. With this in mind the Supply Priorities and Allocations Board is aiming to keep all industries in running order even though they are not engaged in defense work. While some plants may not be permitted to purchase new units, the policy adopted is to permit repair parts to be purchased by all who need them, but it will be expected that inventories of such repair parts will be kept at operating minimum levels.

◆ **MATERIALS** . . . The Office of Production Management has issued an order which prohibits after January 1, 1942, the use of copper and copper alloys in a long list of articles where such use is considered non-essential. It is believed that during this emergency these articles can be made of other materials, thus conserving copper for the more essential uses. The order affects the use of copper or copper alloy sheet, strip or screening in connection with building construction, except where necessary for minor repairs and maintenance. It permits the use of these materials to comply with Underwriters regulations or Government safety regulations, also the use for conductors of electricity, in chemical plants, research laboratories and in oil refining, steam and electric generating plants — but in all cases to a limited extent.

It is noted also that copper and copper alloy may be used as condenser tubes, heat exchanger tubes (other than radiators used to control air temperature) and tube sheets in oil refining plants and plants generating steam or electric power where corrosive action makes other materials impractical.

This order points out that the estimated total supply for 1942 is 1,650,000 tons while the total demand is estimated at 2,400,000 tons which is made up of the following items: For defense (all military, including Lend-Lease) 1,050,000; for essential civilian uses, 250,000; and for other civilian uses 1,100,000 tons. Thus a shortage of 750,000 tons is indicated.

Copper is only one of several materials whose use is being controlled by Government order. Aluminum, steel, rubber, zinc and no doubt many other materials used extensively in power plants have been or will be placed under Government control.

In order to comply with Government orders limiting the use of certain materials some of the leading manufacturers are studying the possible effects of using substitute materials in their products. Designers of power plants scheduled for immediate construction are economizing as much as is considered practicable in the use of materials required for munitions by resorting to simple arrangements and staying close to well established practices. Engineers in charge of power production can contribute greatly in furthering the Defense Program by intensifying their drive for economy of production, insuring continuity of operation by greater vigilance in maintenance and repair work, and exercising greater care to prevent accidental damage to or planned sabotage of plant equipment.

The industry of this country is definitely working on a war basis. It is not yet delivering its full capacity along this line, but the tooling up is well on the way. In nearly every phase of the Government's activity, mechanical and electric power are indispensable elements. Hope still exists in Washington that a shooting war may be averted by all-out, co-operative defense measures.

◆ **NO CHRISTMAS LIGHTS** . . . Well that was the order for at least some sections of the country, but it has been modified to permit tree lighting in homes. The Southeast is dry—that is, rainfall has been abnormally low so a power conservation program has been developed by the OPM designed to assure full and uninterrupted operation of defense plants in that section of the country. Forty power companies in thirteen states will be affected and all but seven groups of consumers are listed in the order.

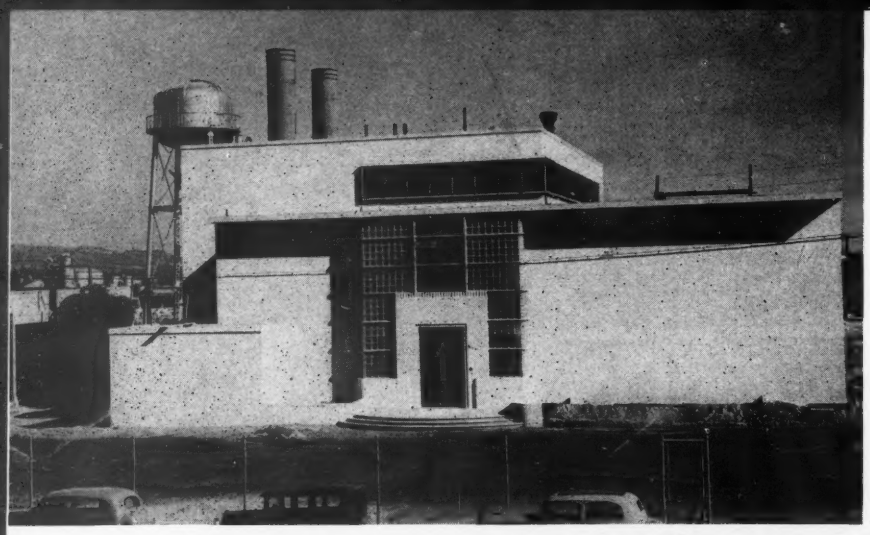
Specifically prohibited under the order are sign lighting, show-window lighting, outline and ornamental lighting, outdoor lighting including floodlighting or field lighting for amusements or sports, and interior or exterior lighting for decorative or advertising purposes.

The order has been so formulated that the residential and small commercial consumer will not ordinarily be affected except that he may not use any power for the prohibited services. That means no outdoor Christmas lights, no canopy of brilliant lights over city streets, lights will not draw you to the movies, they will not be an accomplice assisting in taking money out of your pockets for trinkets. The spirit of Christmas will find some other way of making its presence known. It always has.

Big industries, however, were given a mandatory order effective November 17 freezing the use of power in the affected district to the amount they used during the month of September. It is expected by this order to prevent a few large users from taking more than their share of the power available. There is a possiblity that a 30 per cent cut for all non-defense plants using more than 10,000 kw-hr. a month might be ordered, a proposal which has been deferred several times. Some recent rains and the blackout, pooling arrangement have relieved the conditions somewhat.

Nevertheless the situation is serious for it is reported that the water estimated to be in storage for power purposes the first of November in all the reservoirs in the affected area represents only 4 wk. of power supply, and reserve capacity in fuel burning plants has not been adequately provided to take care of the constantly increasing defense loads.

No doubt many communities, other than those in the thirteen states affected by the order, would find some curtailment in nonessential lighting a desirable measure to conserve fuel and power for the more necessary requirements of industry.



BURBANK'S

By J. B. Johnson
Senior Mechanical Engineer
Public Service Dept.
City of Burbank, Cal.

BURBANK, Cal., began the construction of a steam electric power plant early in 1940 to serve the rapidly expanding aircraft industries and defense projects located within its boundaries. Prior to this, the City had been purchasing power from the City of Los Angeles in addition to its allotment of Federal hydro-power from Boulder Dam[1] and which has been found to be wholly inadequate for present needs.

Present plans of the City contemplate a steam electric generating plant of 30,000-kw. capacity in three units of 10,000-kw. each, the first unit of which went into operation on October 1, 1941, and which is described more in detail in this article. The second unit, practically a duplicate of the first, is scheduled for completion late in 1942.

The plant is municipally owned and operated by the Public Service Department of the City and which furnishes electric power, light and water to the consumers and industrial works located in Burbank. The construction work is being handled by both force account and contract under the direct supervision of the Department. It will operate in parallel with the City of Los Angeles and Boulder hydro-electric generators.

Design Conditions

Basic factors given primary consideration in the selection of equipment and plant design may be stated as follows: 1, high economy under load—as far as consistent with initial plant cost; 2, ability to pick up load quickly while operating as stand-by; and 3, ease of operation with automatic control of vital plant functions.

In the selection of steam pressure at 625 lb. gage and superheat at 825 deg. F., a comprehensive analysis was made of steam turbine economy vs. initial plant cost. Plotting curves for power costs per kilowatt-hour at various steam pressures and superheats and another curve for these costs due to plant amortization only, the lowest point on the composite curve fell close to the condition point selected. This pressure and temperature also falls within that allowable for carbon steel and carbon-moly steel for valves and piping and does not require the use of the chrome-nickel alloys. This has proved of great advantage as these latter alloys are difficult, if not impossible, to procure for any work not directly connected with government defense projects.

As the plant will operate in parallel with Boulder, it was deemed advisable to design the plant for quick pick-up of load in the event of failure of the hydro-electric power from the Boulder system. It should be borne in mind that the Boulder generators are 300 mi. distant and the transmission lines carrying current at 287,000 v., traverse urban territory at the western end while the other or eastern section crosses a desert and mountainous terrain subject to extremes of atmospheric disturbances. There are very definite advantages of a steam power plant close to the load and not subject to transmission line outages.

It is planned that with the turbine spinning under stand-by operation the plant can be brought to pickup load rapidly using the automatic combustion control and a small accumulator reserve in the boilers. The boilers will operate at a stand-by pressure approximately 150 lb. above the pressure at which the turbine will carry its full rated load, and is so regulated by the steam flow meter that the boiler drum pressure drops to within 40 lb. of turbine inlet pressure when turbine is taking its full load of steam. The effect of this pressure differential between boiler and turbine is to maintain sufficient steam pressure, during the time lag between the initial impulse of steam pressure drop and the response of the automatic combustion control, to bring the system into equilibrium after a sudden load has been imposed on the generator.

Boiler Accumulator Effect

It is essential that the accumulator effect of the high boiler pressure maintain steam pressure at the turbine throttle for a period of 2.5 min. which should allow ample time for the combustion control system to respond to the master controller and bring the boiler furnace conditions into balance with the steam demand. The feedwater control operates simultaneously with the combustion system and maintains constant water level in the boiler drum at all steam loads. The control of feedwater and combustion is designed to be fully automatic so that the operator does not need to as much as press a button to adjust the boilers from one load condition to another. Selector switches, however, mounted on the boiler control panels, are provided for manual control, should that be desired or necessary under emergency or unusual conditions.

The first unit of the generating station consists essentially of one 10,000-kw. 0.8 p.f. turbo-generator and two integral furnace type 120,000 lb. water tube steam generators equipped with tubular air heaters and mechanical combination oil and gas burners. The fuel system is described more in detail later. Mechanical draft is produced by duplex fans, both forced and induced draft fans

[1]Reference is made to the September, 1940, issue of POWER PLANT ENGINEERING for other details in this connection.

MODERNISTIC DESIGN Gives Low Cost and High Efficiency

California city builds new 625 lb. 825 deg. F. gas and oil fired plant to supplement Boulder Dam power and carry defense loads. First 10,000-kw. unit in service, second schedlued for the fall of 1942. Cost $95 per kw., heat input about 13,200 B.t.u. per kw-hr. gross at full load. Will pick up full load quickly; 150 lb. accumulator effect in boiler will maintain rated throttle pressure 2.5 min. to allow combustion equipment time to get into operation. Semi-outdoor design and earthquake proof construction

being attached to one shaft and driven by two motors both connected in tandem to the fan shaft. The small motor, 75-hp., carries the air load up to 5000-kw., above which the 300-hp. high speed motor picks up. As the small motor is slower in speed it idles on the fan shaft while the large motor carries the load and visa versa when the small motor is carrying the load.

Automatic control functions to regulate combustion air by means of compressed air drive-units connected by mechanical linkage to control vanes located in the inlets of both fans. The same loading air pressure which controls the fan inlet vanes also operates pressure relays, which automatically cut out one motor and cut in the other in conjunction with the entire control system, when the load swings from one fan range into the other. The change from low to high takes place at a point some 15 per cent above the change over from high to low to avoid hunting in the middle load range.

The house generator is a 750-kw. steam turbine generator, designed to run non-condensing, but can operate condensing by valving the exhaust into the main condenser. It is designed for automatic starting, the relay system being energized by a drop in voltage of the main generator bus. The steam inlet valve is hydraulically operated from oil pressure generated by a dual motor driven oil pump. This makes it possible to start the unit from either the auxiliary a.c. power or storage battery d.c. power.

Main condenser is an 8000 sq. ft. unit with divided water box and two-pass tube arrangement. The circulators are single stage centrifugal pumps with a capacity of 7000 g.p.m. each or 10,000 g.p.m. when operating both in parallel. The cooling water is circulated through a mechanical draft, induced type, cooling tower. In this type of tower the fans, six in number, are located at the top of the tower and are driven by electric motors, connected through gear drives and universal couplings, to the fans, located so as to be outside of the air stream. The boiler feed system comprises one triplex power feed pump and two centrifugal multi-stage feed pumps. All are electric driven at constant speed and their operating and control features are described later. The regenerative and make-up system consists of: four surface type tubular feedwater heaters; one direct contact deaerating type heater; one low-pressure flash tank; one single effect evaporator of 3200 lb. per

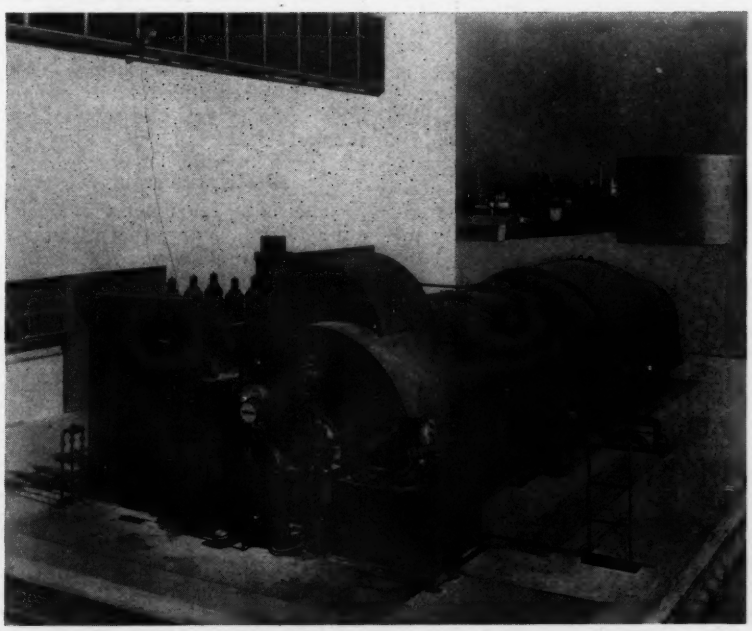


Fig. 1. The turbine and generator are installed outside. The unit can be serviced by a special gantry type crane, with a cantilever bridge, which operates on a ground runway adjacent to the building structure. The photo in the upper left hand corner of the opposite page is a view of the plant from the front. A corner of the cooling tower is visible at the left and the substation and incoming Boulder Dam lines are just outside the photograph at the right. Photos by Corwin Hansen, San Francisco

hr. capacity; one small evaporator condenser; one continuous blow-down flash tank; and one tubular fin-type heat exchanger. The flow diagram is shown by Fig. 4.

Water-softening and treating equipment consists of a sodium zeolite softener, for cooling tower and boiler make-up, supplemented by a coagulant feeder and blow-down deconcentrator to operate only on boiler make-up in conjunction with the evaporator. It is expected by this method to keep the total solids in the boiler make-up water to a point below 15 p.p.m. and the hardness to less than 2 p.p.m. Boiler water will be further conditioned by the addition of sodium phosphate pumped proportionately directly into the boiler drums and controlled automatically by electric contacts located in the integrating mechanism of the feedwater flow meters.

The feedwater make-up treatment has been designed with special consideration given to dissolved oxygen, silica carry-over from the evaporator and caustic embrittlement within the boilers. Deaerator, deconcentrator and phosphate feeder are the answers, respectively, that are expected to overcome these troubles. It is likely, however, that additional treatment in the form of some colloidal reagent may be found necessary in the future. Recent advanced practice in the use of colloidal iron, also sodium compounds in colloidal form, indicate their effectiveness in high-pressure boilers especially in the scavenging of oxygen and the complete entrapment of silica, both of which elements are prolific sources of trouble if they pass through the evaporator and deaerator into the boilers.

Water for the plant will be supplied by a ground well pump, the bulk of which will be used as cooling tower make-up. It will be dosed with chlorine to prevent algae growth in the basin of the cooling tower and to keep slime and scale from the condenser tubes.

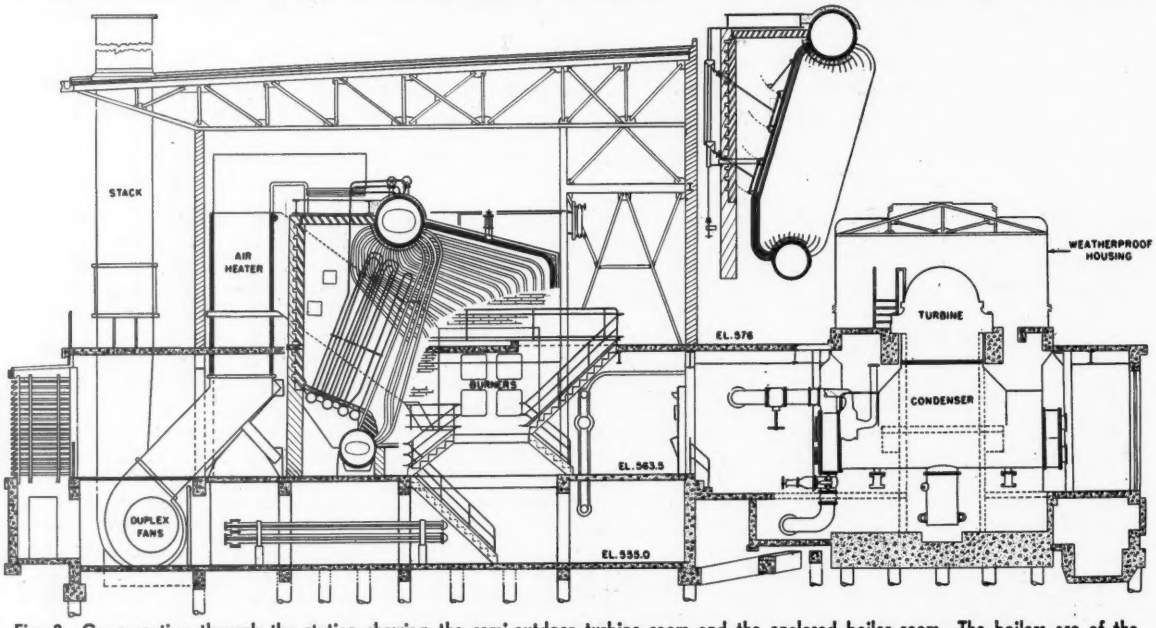


Fig. 2. Cross section through the station showing the semi-outdoor turbine room and the enclosed boiler room. The boilers are of the integral furnace type and the section shown is through superheater. The insert shown above and at the left of the turbine is a section through the gas bypass for steam temperature regulation. This type of boiler is fired from one end of the furnace (what is the side in the above view) and the four burners and firing platform are indicated above

Electrical Features

The main generator will operate at 4500 v. and the auxiliary generator at 2500 v. All of the rotating auxiliary equipment is electric motor driven with all motors up to and including 75-hp. operating at 480 v., the larger motors at 2500 v. Motor starters with a few exceptions are located on the switchboards with the control switches grouped in a convenient location in the main operating aisle of the plant. Two main switchboards, 480 and 1500 v. respectively, are placed in separate rooms adjacent to the plant auxiliaries. The 2500 v. switchgear is enclosed in metal clad compartments designed for individual removal of any switch by jack lift.

Main generator leads connect direct to the 4500 v. bus of the city's distributing switch rack, and are protected from outside atmospheric or other disturbances by surge protecting apparatus of the oxide film type.

Protection against overheating from internal short circuits or normal heat accumulation in the generator coils is provided by a closed-circuit air plenum cooling system, the air being supplied by fan blades attached to the generator rotor and cooled by water circulated through a fin-type air cooler connected to the auxiliary cooling system. Local hot spots are detected by resistance temperature coils placed in nine different locations in the stator and connected to temperature indicators placed outside.

A stationary battery of CO_2 cylinders is also being installed to protect the generator against fires resulting from short circuits or other causes. This is an automatic piece of equipment which is controlled by the generator differential relay, also by thermostats placed in the air stream. The initial charge of CO_2 released by the trip valve, in the case of emergency, is gaged to fill the plenum with a 25 per cent CO_2 atmosphere and the delayed

charge of CO_2 from the remaining cylinders will maintain this atmosphere for 30 min., which will effectually smother any fire.

A station storage battery at 125 v. has been installed for its normal use in the remote solenoid operation of circuit breakers and for emergency use in starting the auxiliary generator and emergency lighting in the plant in the event of a complete failure of a.c. power. Troubles at vital points in the plant will register on annunciators in the control room and simultaneously in the boiler aisle and will continue to show until the trouble has been cleared.

Structural Features

Ground soil at the plant site is an alluvial deposit of interstratified sand and loam with an admixture of fine gravel at a depth of 25 ft. As these conditions did not favor floating foundations, steel piles were driven to a depth varying from 25 to 30 ft. to support the entire plant and equipment, each pile being driven to 30 ton loading value. The main turbine rests on piles and a pile cap structure of reinforced concrete separated from the remainder of the building.

During the preliminary stages of the design an honest attempt was made to design an outdoor plant, not so much to be in keeping with California tradition, but that building and structural costs might be reduced. The final result, however, was a semi-outdoor type of plant, all the equipment being covered with a building and roof somewhat after the conventional manner with the exception of the main turbine. This unit has a metal enclosure separated from the main building, and with room enough inside for inspection and operation of the turbine. The generator is protected by a weatherproof housing similar to outdoor type motors, and the exciters are similarly protected. The manufacturers of this equipment met with some unusual problems in its design, and with serious problems in erecting the turbine, as the work of necessity had to be performed outdoors.

In usual California weather this would have presented no obstacles, but as it was done during the winter months when southern California experienced a record rainy season, the delays and difficulties of the work can well be appreciated by construction engineers. The weatherproof turbine enclosure is designed with a removable roof, constructed so that it can be lifted off by the overhead crane whenever major repairs or inspection may be required on the turbine. Minor repairs and adjustments can be made inside the housing enclosure without removing the roof.

The service crane is a gantry type with a cantilever bridge designed to operate on a ground runway adjacent to the turbine structure with the bridge overhanging the turbine. The entire weight of crane and loaded hook is supported on the ground adjacent to the building and the building structure is entirely relieved of these loads and their lateral forces imposed by them.

Although a special crane of this type is costlier than a standard gantry spanning the turbine, and considerably more costly than the conventional overhead traveling crane, the extra cost is more than offset by the saving in structural cost of the building. This may not be apparent to Eastern engineers not familiar with the requirements of the State of California in regard to earthquake-proof structures, which must be designed to withstand lateral forces from one-fifth to one-half the vertical loads.

Turbine Deck Design

The plant as designed virtually has all the steam auxiliary and electrical equipment under the turbine deck and control house. The turbo-generator unit is supported on a concrete foundation, with the turbine deck 18 in. below the elevation of the turbine bed plate. The turbine deck presented another structural problem in that it is of necessity both a floor and a roof, and cannot be constructed leak-tight as a roof since it must serve as a floor. A membrane of some kind over the concrete slab is suggested for leak-tight construction, but is out of the question as a floor covering for a turbine deck.

Saving in building cost of an outdoor plant vs. a heavy building with overhead traveling crane is probably a considerable item, especially so in California, where earthquake conditions must be met. However, the advantages are not all in favor of an outdoor type of plant. Electric switchboards, turbine and boiler control panels must of necessity be completely housed, boilers and other equipment that do not require an overhead service crane are protected from weather by a canopy type of roof and with only partial side walls.

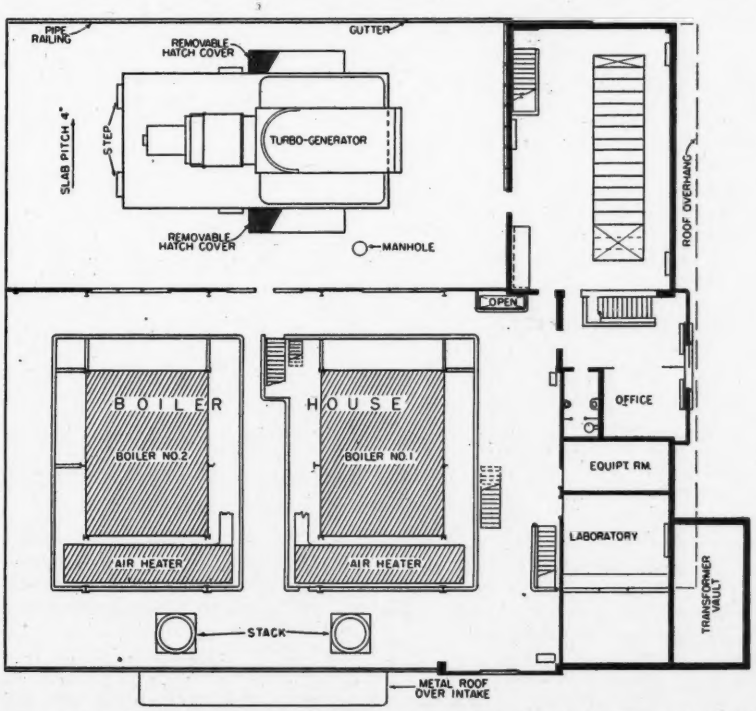


Fig. 3. Plan of the main operating floor of the station showing the two boilers, turbine and other sections of the building. The plant will be extended to the left for Unit No. 2

Arrangement of turbine auxiliaries and operation of regenerative cycle are shown in flow diagram, Fig. 4. Five stage extraction feedwater heating is employed, although the main turbine is provided with only four extraction points. Four stage heaters are the tubular surface type, the fifth being a direct deaerating type of heater which does not use any extraction steam when the turbine is operating at or near full load. All low-pressure drips gravitate to the low-pressure heater No. 4 and mix with the main condensate flow before entering the deaerator.

High-pressure drips and high-pressure heater condensates flow direct to the flash tank before entering the deaerator, thus saving some deaerator capacity, as only the flashed vapors enter the deaerator, the water passing directly to the feedwater surge tank located under the deaerator. The flash tank also serves to take the bypassed discharge from the feedwater pumps, since the feed pump discharge header is maintained by the pressure-regulating bypass valve at a constant pressure of approximately 750 lb. gage.

This feature has been introduced largely because of the use of a triplex, constant speed, motor driven feed pump, for operation at low boiler loads and stand-by operations. This pump will carry one boiler up to 40 per cent of its capacity and within this operating range offers an appreciable saving in power over the centrifugal type of pump, the ratio of efficiencies being about 90 to 50 in favor of the former. An automatic arrangement actuated by electric contacts in the totalizing feedwater flow meter is designed to cut out the triplex pump when its capacity has been reached and cut in one of the two centrifugals either one of which will feed one boiler to its full capacity. On a down-swing in load the reverse operation automatically takes place.

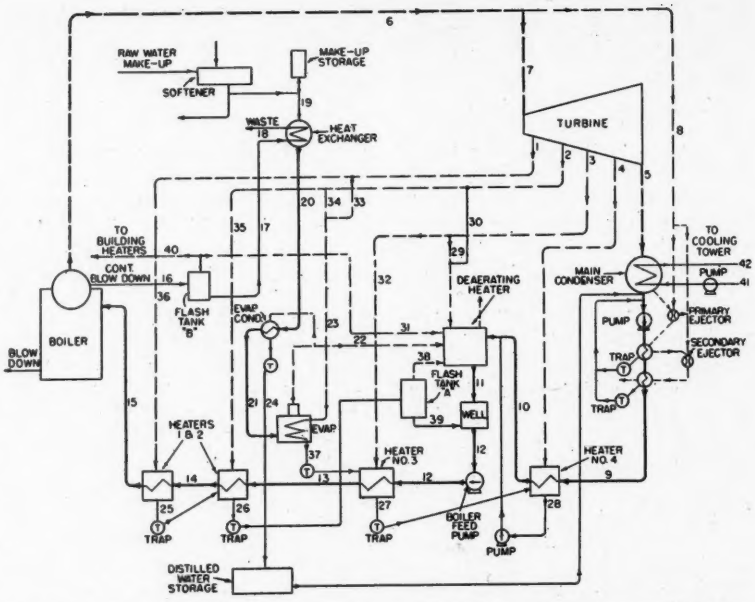


Fig. 4. Flow diagram of Unit No. 1. Figures on this diagram refer to corresponding items in the heat balance tabulation Table I. Note that B.t.u. values on the tabulation are based on full load and one kilowatt hour at the generator terminals

The regenerative cycle is planned to return the feedwater to the boiler at not less than 290 deg. F. at low loads, and at 376 deg. F. at full load. It is to be noted that the system is designed so that the deaerator remains at constant pressure of 18 lb. abs. under all load conditions and is the spot where the system is balanced. This is done by a controlled steam connection to the extraction lines from the main turbine, designed to admit steam through a pressure regulating valve. Whenever the extraction line pressure falls below the desired deaerator pressure, the relief type regulating valve in that extraction line closes and the pressure regulating valve in a higher pressure line opens automatically and maintains the steam supply to the deaerator.

Evaporator will be maintained at a vapor pressure of 30 lb. abs. at all loads and steam to the coils is controlled in a manner similar to the deaerator, except that the next higher extraction steam line is used. The vapor is passed directly to the deaerator as needed for boiler make-up and the excess over make-up needs passes to a

Table I. HEAT BALANCE AT FULL LOAD. All values are per kw-hr. at the generator terminals. Figures in parentheses thus (7) refer to positions on the flow diagram in Fig. 4.

Flow Line	P p.s.i. abs.	t Deg. F.	w weight lb.	h enthalpy B.t.u./lb.	B.t.u. Total
Steam to Turbine (7)	640	825	10.22	1,421	14,523
Steam to Air Ejector (8)	640	825	.03	1,421	43
Extraction Steam to Heater (1)	223	627	.675	1,334	909
Extraction Steam to Heater (2)	100	470	.645	1,263	816
Extraction Steam to Heater (3)	35	289	.59	1,183	711
Extraction Steam to Heater (4)	10	194	.54	1,107	600
Exhaust to Main Condenser (5)	2" Hg.	101.17	7.77	1,039	8,074
Extraction Steam to Evaporator (34)	100	375	.16	1,212	194
Condensate to F. W. Heaters (9)		104	7.80	72.6	567
Cooling Water to Condenser (41)		78	500	46	23,000
Cooling Water from Condenser (42)		93.1	500	61.08	30,537
Water fed to Boilers (15)		376	10.43	348.6	3,635
Make-up Water to Heat Exchanger (19)		60	.15	28	4
Make-up Water to Evaporator (21)		172	.15	140	21
Make-up Vapor from Evaporator (22)	30	250	.15	1,163	174
Boiler Blow-down (continuous) (16)		490	.15	477	72
Boiler Blow-down (continuous) Waste (18)		199	.12	167	20
Boiler Mud Drum Blow-down Waste		490	.03	477	15
Exit Flue-gas Loss (oil fuel)					2,080
Exit Flue-gas Loss (gas fuel)					2,210
Heat Input to Boiler in Fuel Oil					13,150
Heat Input to Boiler in Fuel Gas					13,280
Radiation Losses from Boiler					53
Radiation Losses from Auxiliaries and Piping					48
Air Ejector Losses					13
Heat consumption of Turbo-Generator including excitation, ventilation, windage, friction and all turbine radiation losses					10,950

small condenser which supplies distilled water to the distilled water storage. The deaerator overflow also discharges into the distilled water storage tank.

Table I covers the calculated heat balance for the plant giving the pertinent temperatures and pressures at various points of the system, also fluid quantities and B.t.u. values, all figures being reduced to values per kw-hr. at the generator terminals. Figures as (7) correspond to line numbers in the flow diagram Fig. 4.

Except during winter months when it will be necessary to burn fuel oil during periods of inadequate gas supply, the plant will operate on natural gas fuel. The conservation of the natural gas resources of the State necessitates curtailment of gas used during the winter months. Gas is brought into the plant from the Southern California Gas Co.'s mains and is maintained at 30 p.s.i. ga. pressure ahead of the regulating valves and varies from 5 to 12 lb. pressure at the gas burners depending on boiler load.

Fuel oil system comprises a 25,000 bbl. storage tank, three 10,000 gal. day service oil tanks with tubular suction tank heaters at both places. Steam at 250 lb. pressure is used for heating. Positive displacement pumps are used to force the oil to the burner circuits at a pressure which will vary from 250 to 300 lb. gage. Each boiler is further equipped with a differential pressure oil pump which maintains a constant pressure differential across the burner orifices and boosts the oil pressure to approximately 350 lb. at the burner orifice. Heaters in the oil circuits are capable of bringing the oil temperature up to 350 deg. F. and since a heavy fuel oil may be used this temperature may be reached.

Fuel oil has been, for many years, considered a by-product of the large oil refining plants in Southern California and consequently low in price. During the past year, however, the demand has improved and the oil companies are prepared to offer fuel oil which consist of residues from cracking process blended to definite specifications as to heating value, viscosity and pour point. This is meeting the need of industrial users and steam power plants in a very definite way and aids in determining the character of fuel equipment needed as well as operating costs. The city has not at this writing purchased fuel oil for the coming winter season, but it is expected that this will be a 7 A.P.I. cracking residuum with a heating value of not under 152,000 B.t.u. per gal.

LIST OF EQUIPMENT CONTRACTORS AND MANUFACTURERS, CITY OF BURBANK PLANT

	EQUIPMENT	CAPACITY	CONTRACTOR OR MANUFACTURER
1.	Main turbo-generator	10,000-kw., 4,500 v.	Allis-Chalmers Mfg. Co.
2.	Auxiliary turbo-generator	750-kw., 2,500 v.	Terry Steam Turbine Co. Crocker-Wheeler Co.
3.	Steam generator (2)	120,000 lb. per hr. each	Babcock & Wilcox Co. C. C. Moore Co.
4.	Main condenser and condensate accessories	8000 sq. ft.	Elliott Co.
5.	Cooling tower	10,000 g.p.m.	Marley Co.
6.	Circulating water pumps (2)	10,000 g.p.m.	Ingersoll-Rand Co.
7.	Forced draft fans	25,000 c.f.m.	B. F. Sturtevant Co.
8.	Induced draft fans	43,000 c.f.m.	B. F. Sturtevant Co.
9.	Ducts and flues		Lacy Mfg. Co.
10.	Automatic combustion control		Bailey Meter Co.
11.	Evaporator	3000 lb. per hr.	Griscom-Russell Co.
12.	Surface feedwater heaters (4)		Struthers-Wells Co.
13.	Deaerating fw. heaters	100,000 lb. per hr.	Cochrane Corp.
14.	Evaporator condenser		Ross Heater & Mfg. Co.
15.	Cent. boiler feed pumps (2)	210 g.p.m.	Byron-Jackson Co.
16.	One Triplex feed pump	100 g.p.m.	Union Steam Pumps Works
17.	Feedwater treating equip., zeolite softener and coagulant feeder		Elgin Water Softener Corp.
18.	Chemical feed pumps		Proportioneers, Inc.
19.	Fuel oil pumps (3)	30 g.p.m.	Quimby Pump Co.
20.	Fuel oil heaters		Griscom-Russell Co.
21.	Fuel oil tank heater		Ross Heater & Mfg. Co.
22.	2,500 v. switchgear	10 panel	General Electric Co.
23.	480 v. switchboard	24 panel	W. A. Benjamin Electric Co.
24.	Control and relay sw. bd.	20 positions	W. A. Benjamin Electric Co.
25.	Storage battery	125 v., 240 amp. hr.	Gould Storage Battery Corp.
26.	Station transformers (2)	500 kv-a., 2500/480 v.	Gardner Electric Co.
27.	Hi-pressure steam traps		V. D. Anderson Co.
28.	Standard steam traps		Illinois Eng. Co.
29.	Hi-pressure valves		Chapman Valve Mfg. Co.
30.	Std. steam & water valves		Crane Co. Reading, Pratt & Cady Co.
31.	Extraction line valves		Atwood-Morrill Co.
32.	Pressure regulating valves		Fisher Governor Co.
33.	High pressure piping	625 p.s.i., 825 deg. F.	Associated Piping & Eng. Co.
34.	Auxiliary piping	Med. and low-press.	Midwest Piping & Supply Co.
35.	General building contract		Harman & Co.

Power Costs

In comparing costs of power generated by fuel burning plants and hydroelectric plants the costs of hydro power at the generator switchboard will usually fall below the figure for fuel burning plants. However, in most instances the transmission cost of hydro power will more than off-set the saving in generating cost, with the final result in favor of the fuel burning power plant. Such is the case with the city of Burbank, as, has already been mentioned, the hydro generators are some 300 mi. distant, and the heavy cost of transmission line construction puts a correspondingly heavy fixed charge against the power transmission cost to the city.

It is of interest to note that the contract price of hydro power which is being charged to the city by the Federal Government at 1.163 mills per kw-hr. is slightly under the estimated fuel cost at the steam plant, operating at an average plant load factor of 50 per cent. Operating and fixed charges are estimated to vary from 1.5 to 3 mills per kw-hr. corresponding to plant load factors of 100 and 50 per cent. Fixed charges are based upon a total estimated plant investment of $950,000 for the first 10,000-kw. unit. At the 50 per cent factor the total estimated power cost is about 4.5 mills per kw-hr. or somewhat less than the present price of purchased power.

The plant was designed by the local engineering staff of the City's Public Service Department assisted by Carl A. Heinze, Consulting Electrical Engineer and D. A. Elliott, Consulting Architect. J. H. McCambridge is the Superintendent of the Public Service Dept.

BYPRODUCT POWER From Process Gases

By John Goldsbury and
John R. Henderson
Turbine Engineering Dept.
General Electric Co.

Gas turbines, or more correctly combustion-gas turbines, the rotary counterpart of the Diesel to both burn the fuel and transform the heat into power, have had an up and down history. The field has been subject to intense experimentation, but little practical progress was made until recently. Such units are actually in service in Europe for power generation. More recent developments indicate the possibility of utilizing still higher temperatures which will place it in a competitive position with steam plants. There is, however, a different branch of the same family which has many practical industrial applications today, services comparable to reducing valve steam turbines and waste heat boilers where it is desirable to get the maximum energy recovery from waste industrial or process gases and vapors. This type of gas turbine and its application was described by the authors at a recent A.S.M.E. meeting; typical uses are mentioned; charts for determining the possible power recovery and temperature drops are given; and a comparison made between turbine size and design for different gases available for use

MANY MODERN industrial processes involve the production or use of gases or vapors under pressure because certain reactions take place more effectively and the gain in the quality or quantity of the product is often well worth the cost of air or gas compression. Whenever a continuous flow of gas is available under pressure above atmosphere, it will be well to consider whether advantage cannot be derived from expanding the gas through an elastic fluid turbine.

This term elastic fluid turbine is used to denote the general class of turbines which are operated by the expansion of any gas or vapor. The general features are the same as those of the steam turbine, but the dimensions (see Fig. 4), materials and design details will be determined by the particular fluid used as well as by the pressures and temperatures involved.

Certain processes may be improved or operated more economically by the installation of turbines to derive power from the expansion of gases whose energy might otherwise be wasted or inefficiently used. In some cases the reduction in temperature resulting from expansion through a turbine may be more important than the power obtained. By expanding gases through turbines rather than wastefully through valves and small pipe lines, power can often be derived which will replace power derived from the burning of fuel and thus help to conserve our fuel resources.

In general, the justification for a turbine would be the power which it could produce, but an increasing number of processes are being considered in which the advantage of the turbine is the reduction in gas temperature due to the energy absorbed by the turbine. At least one such application has been made and several others have been considered.

The most important development so far in the use of turbines driven by industrial process gases other than steam is found in connection with certain catalytic petroleum refining processes. In these processes carbon is deposited on the catalyst. The carbon must be burned off and the catalyst regenerated at frequent intervals. In several of these processes it is apparently most effective and economical to burn off the carbon under pressure and in some cases the pressure is as high as 300 lb. Much higher pressures have been proposed.

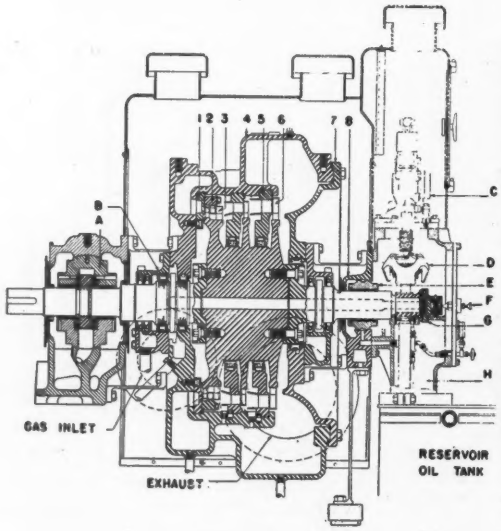


Fig. 1. Cross section of a 3500-hp. turbine used for byproduct power recovery in connection with gases from a catalytic petroleum refinery process. Numbered and lettered parts are as follows: 1, nozzle plate; 2, intermediate; 3, bucket wheel, 1st stage (rotor); 4, high-pressure head; 5, nozzle diaphragm, 3rd stage; 6, bucket wheel, 3rd stage (rotor); 7, low-pressure head; 8, bearing bracket, L. P. end; A, thrust bearing; B, shaft packing; C, primary pilot valve; D, speed governor; E, bearing linings; F, oil trip valve; G, emergency governor; H, oil pump

The heat could, of course, be partially recovered in a waste heat boiler or other type of heat exchanger, but the pressure potential would be largely wasted. The pressure potential can be utilized and a large portion of the heat removed by passing the gas through a turbine of the type shown by Fig. 1, the cross section of a 3500-hp. machine.

The diagram in Fig. 2 shows the control arrangement for this turbine. The mechanism is such that speed can be held constant at any set value within the setting range of the governor, in this particular case, from 2800 to 4000 r.p.m. The speed governor (a) controls a single admission valve (b) through an oil operating cylinder, not shown. In order to assist the speed governor in holding constant speed in spite of large variations in gas main pressure, a constant pressure governor (c) is used to control the pressure ahead of the speed governing valve. The pressure gov-

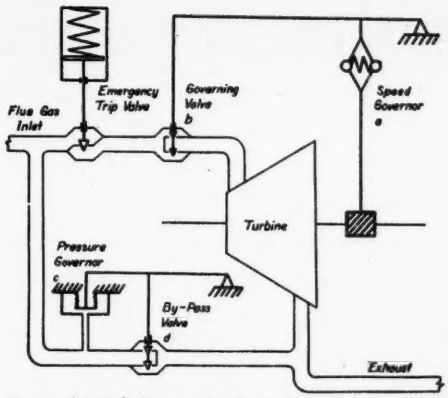


Fig. 2. Control diagram for the turbine shown by Fig. 1

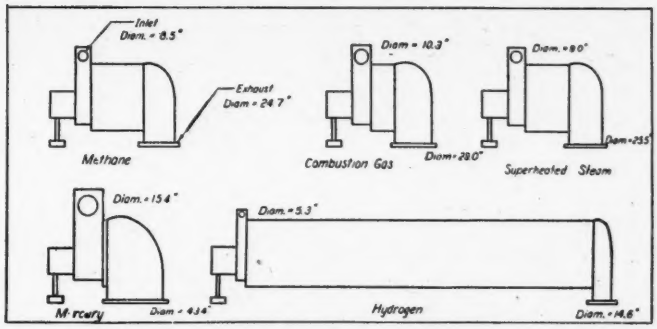


Fig. 4. Comparison of turbine sizes for different gases based on 3500-hp., 170 lb. ga., 1000 deg. F. at inlet and 5 lb. ga. backpressure. Single stage mercury turbine is assumed. With other gases the number of stages is proportional to the available energy per pound of gas. The barrel lengths of the above machines are drawn proportional to the number of stages. The inlet diameters are based on 1 per cent pressure drop and the exhaust on 1 per cent pressure drop and 70 per cent internal efficiency

ernor controls a valve (d) which bypasses excess gas round the turbine. This particular turbine was designed to be installed out of doors, and the sheet metal lagging, oil tank cover, etc., were consequently made weatherproof.

In Fig. 3 is shown the control diagram for another flue gas turbine of 885-hp. capacity. In this case a 1460-hp. steam turbine is coupled to the same shaft for starting and for supplementing the gas turbine power. Referring to the diagram, it will be seen that both turbine admission valves, (b) and (d), are controlled by one speed governor (2) through oil relays. The linkage is arranged in such a way that the gas turbine valve (d) opens first, the steam turbine valve (b) then opening to whatever extent is necessary to make up the difference between the load required and the power which can be obtained from the gas turbine under the particular conditions considered. The steam valve has an overtravel in the closed position, so that it does not lift above its seat until the gas valve is nearly wide open.

Although there is only one speed governor, a separate emergency overspeed governor is provided on each turbine, to prevent runaway of either turbine in case of loss of its load. The emergency governor (f) on the gas turbine will dump the oil pressure from the gas admission valve cylinder (e) only, while the emergency governor (g) on the steam turbine will dump the oil pressure from both the gas (e) and steam (c) admission valve cylinders, to cover the case of complete loss of load on the compressor.

Another large potential field for power from expansion of gas through turbines is the natural gas industry. Numerous very small turbines of standard steam designs are being operated by natural gas and used to drive pumps and other apparatus.

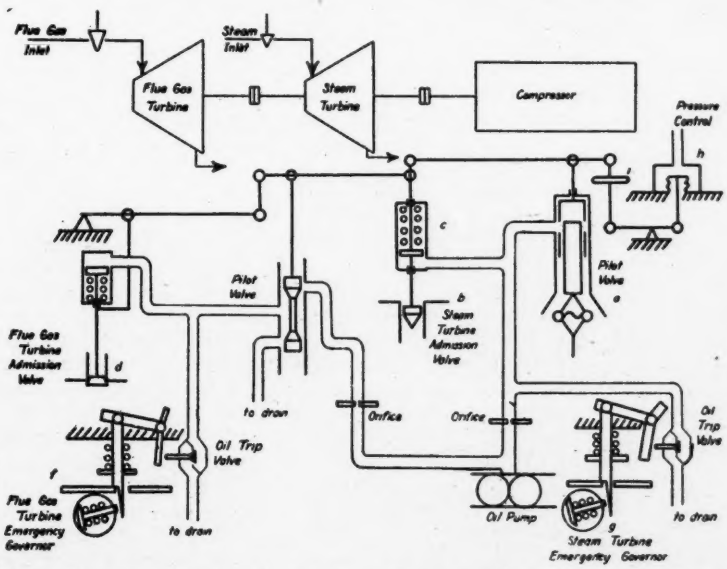


Fig. 3. Governing mechanism for dual drive with a gas turbine and steam turbine both driving a compressor. The mechanism is so arranged that the steam turbine carries the difference between the compressor load and the power available from the gas turbine at the moment

Low Temperatures

In the repressuring process of liquid extraction from natural gas, well pressures run from 1500 to 3000 lb. per sq. in. or more while the pressure in the absorption tower is usually from 1000 to 1500 lb. Since the amount of liquid extracted increases with decrease in temperature, any power extracted by passing the gas through a turbine would contribute also to the yield.

The temperature of natural hydrocarbon gas as it issues from the wells is very low, frequently less than 120 deg. F. When such gas is expanded through a turbine, the temperature at the turbine outlet may be below freezing. This not only requires the use of materials which retain their ductility and strength at such low temperatures, but also introduces a possible difficulty from ice formation. If considered advisable, moisture, hydrates, and even carbon dioxide can be removed from the gas before it enters the turbine.

In one natural gas application where turbines were used to drive electric generators, special precautions were taken to avoid danger

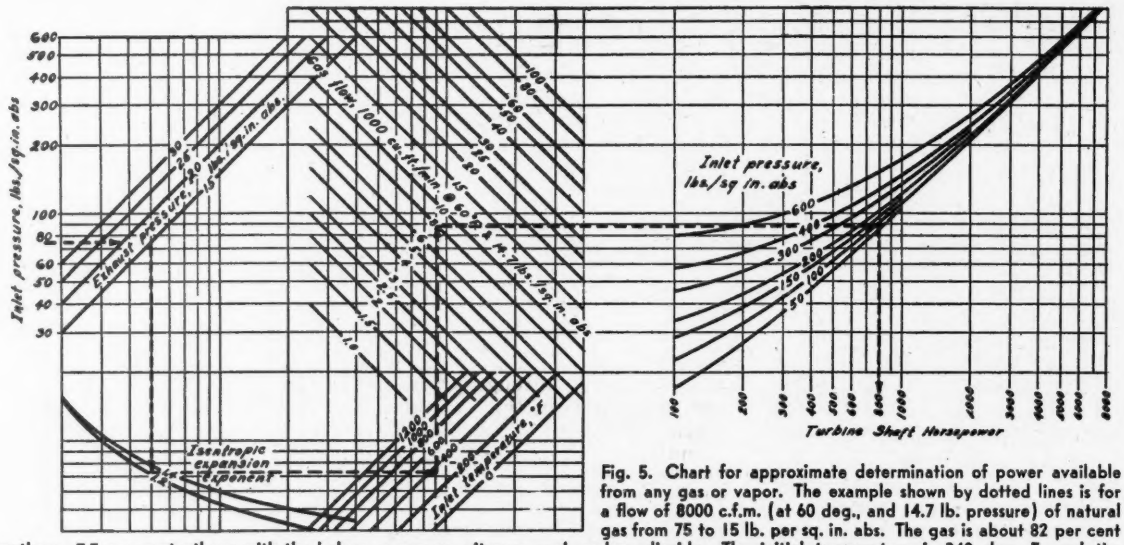

Inlet pressure, lbs./sq. in. abs.
Exhaust pressure, lbs./sq. in. abs.
Gas flow, 1000 cu. ft./min.
Isentropic expansion exponent
Inlet temperature, °F
Inlet pressure, lbs./sq. in. abs.
Turbine Shaft Horsepower

Fig. 5. Chart for approximate determination of power available from any gas or vapor. The example shown by dotted lines is for a flow of 8000 c.f.m. (at 60 deg., and 14.7 lb. pressure) of natural gas from 75 to 15 lb. per sq. in. abs. The gas is about 82 per cent methane, 7.5 per cent ethane with the balance propane, nitrogen and carbon dioxide. The initial temperature is 340 deg. F. and the expansion exponent is approximately 1.24. The shaft horsepower developed would be about 800-hp.

from ignition of gas which might leak from the packings. One of these precautions was the use of a firewall between the turbine and the generator. Another was the use of beryllium copper for the trigger of the emergency overspeed governor in order to prevent sparks when the emergency governor bolt strikes the trigger. An explosion-proof speed synchronizing control motor was also used.

There are, of course, other processes than those mentioned above in which gases are expanded through turbines, but it would seem probable that very much more can profitably be done along these lines.

In order to determine in any particular case whether it will be profitable to expand a gas through a turbine, a calculation or estimate must be made of the power obtainable. The nomograph in Fig. 5 can be used to obtain quickly approximate outputs from given quantities of gases at various temperatures and pressure ratios. A formulation has been introduced whereby turbine efficiency is included on a basis which gives approximately the correct characteristic with respect to size, but of necessity many variables cannot be evaluated in such a chart. For more accurate determinations something must be known of the properties of the gas and suitable methods must be used to calculate the available expansion energy.[1]

The approximate temperature drop from turbine inlet to exhaust can be obtained from the nomograph in Fig. 6 when the horsepower corresponding to a given volume flow and isentropic expansion exponent is known.

[1]Necessary data for detailed calculation for many different gases are given in the original paper.

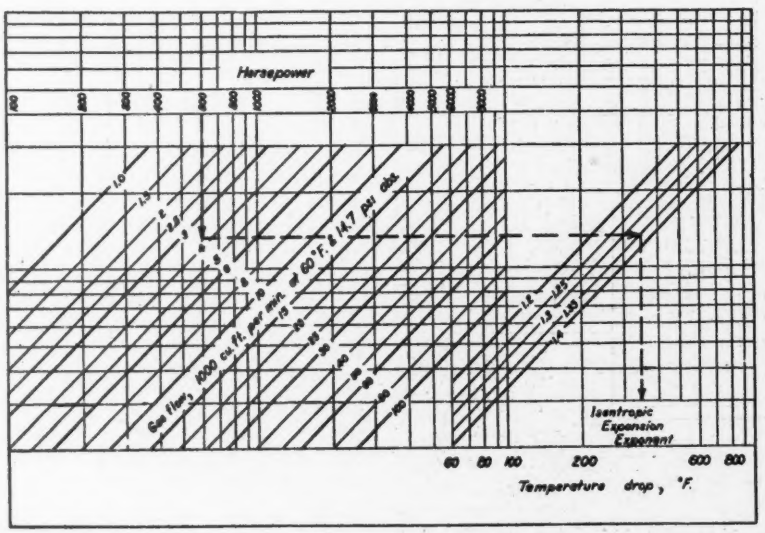


Fig. 6. Chart for determining the temperature drop through a turbine after the horsepower has been determined. The example followed out by the dotted line above is not the same as the one shown in Fig. 5. It is for 600-hp. developed from a flow of 3750 c.f.m. of gas with an expansion exponential of 1.35. The temperature drop would be about 350 deg. F.

The Mystery of the Missing Dowel Pins

JOHN NOWELL, General Electric engineer, had 90 days in which to construct the first large electric plant in the Belgian Congo. On location, he was checking the many parts packed in crates and boxes, to see if everything was there. His inventory tally disclosed that nothing was missing —except the dowel pins. The whole camp was searched, natives were questioned, but not a single steel dowel pin was found.

It was too late to get replacements. So, with some scrap iron rod, improvised iron tools, and unskilled help, Nowell manufactured a new set of pins, and the job was completed on time.

Months afterward a visitor to a half-savage tribe in the Belgian Congo found men and women alike wearing a new type of nose ornament. Thrust through the cartilage of the nose, gleaming and twinkling in the African sunlight, each proud native wore one of John Nowell's missing dowel pins.

New Brine System Boosts Rink Profits

Improved method of circulating brine beneath the ice floor of Pasadena Skating Rink results in quick and efficient freezing. Rink supplied with 200 tons of refrigeration—1 ton per 100 sq. ft. of ice

By OWEN H. BARNHILL

AN IMPROVED METHOD for circulating brine underneath the ice floor of Pasadena's new $200,000 skating rink is entirely automatic. The old system of supplementing the main header-pipe at either end of the room with shorter ones—each of the latter having valves for controlling the flow of brine under different parts of the floor—was discarded on account of time required to regulate brine movement and the difficulty of maintaining an even temperature in all parts of the ice field.

In the new system pumps force brine through a 14-in. feed-pipe which runs under the middle of the floor to the far end of the room, where the liquid empties into a 10-in. header-pipe in the form of an elongated loop. After flowing to the far corners of the room in this conduit the brine passes through the return bends at each end of the loop and runs back toward the center of the floor.

On the return trip brine flows into small pipes, through which it passes the length of the floor, then empties into a 10-in. header-pipe extending across the near end of the room. A 14-in. pipe T's into this receiving header at its middle and conveys brine back to the engine-room.

With this circulatory system shown in Fig. 2 every gallon of brine travels the same distance as every other gallon and at equal speed, thus insuring uniform freezing of the ice floor. The time gained by that portion of brine which enters the small pipes near the sides of the floor is lost in flowing through the receiving header at the other end of the room back to the middle of the floor, one interval offsetting the other.

Although brine enters small pipes near the middle of the room after the others have been supplied, this portion of the liquid reaches the other end of the room near the center of the floor, where the outlet pipe is located. Brine which enters the small pipes first has to travel through the receiving header back to the middle of the floor, time lost and gained thus counterbalancing.

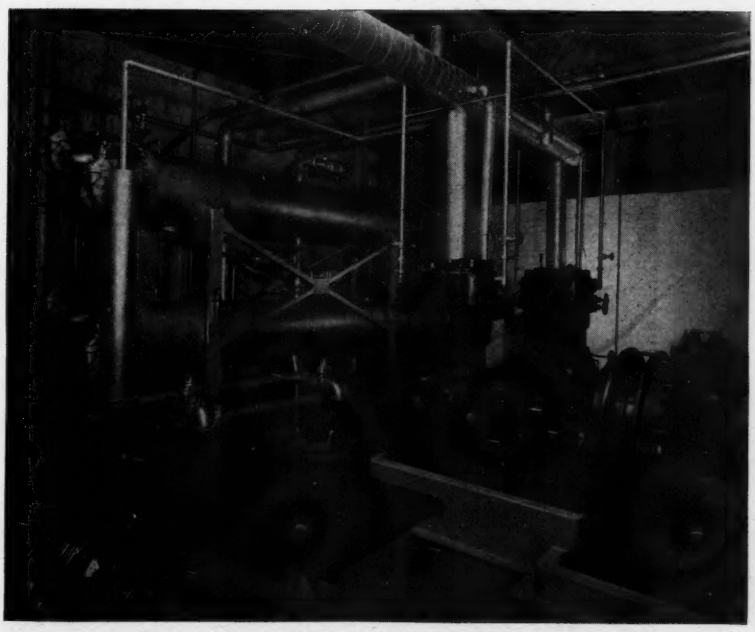


Fig. 1. Two vertical single-acting York ammonia compressors driven by Fairbanks-Morse Synchronous motors supply the refrigeration

Synchronous motors were chosen to operate the ammonia compressors because of their efficiency at the low speed required—360 r.p.m. Speed-reducing mechanism of induction motors would have absorbed part of the power used, increased maintenance and repair expenses and occupied additional floor space. Furthermore, the price of such equipment would have equaled or perhaps exceeded the extra cost of synchronous motors. The latter operate at an efficient unity or leading power factor while induction motors run with a lagging-behind power factor, which becomes excessive at 600 r.p.m. or when only part of a load is carried. A favorable power rate was obtained because synchronous motors raise the power factor.

The skating floor is 105 by 205 ft., covers nearly one-half acre—21,000 sq. ft.—large enough to accommodate 1400 skaters, allowing 15 sq. ft. to each one. The lofty arched Lamella roof is supported entirely by the side walls, giving an unobstructed view of the skating floor and a pleasing outdoor airiness. The rafters are 2 in. by 14 in. by 12 ft., band-sawed on the under side as well as upper edge to give necessary curvature for the gypsum lath ceiling. Ten-foot strips of acoustical fiberboard are placed 10 ft. apart across the ceiling.

The entire building is 155 by 253 ft., providing 6000 sq. ft. of space for power plant, lounge, offices and service rooms. The lounge or foyer is comfortably heated and extends along the entire front side of the skating floor, from which it is separated by a glass partition. The floor is of Douglas fir wood blocks, vertical grain, which withstand wear from steel skate runners without injuring the latter.

Double Groutlock brick walls were built with cement plaster and reinforcing steel, making the structure proof against earthquakes as well as fire. Steel studding was used in the smaller partitions. The roof is anchored to a reinforced concrete girder resting upon the rear Groutlock wall and steel piers in the glass partition wall on the front side.

Eleven thousand gallons of 7 pH brine circulates through 86,000 ft. of 1¼-in. pipes laid 3 in. apart on

centers, extending crosswise over 2 by 6's supported by concrete walls 7 ft. apart. The ice floor was insulated against ground heat by filling the space underneath and between the pipes with sand, which is about 2 ft. deep, and flooding with water before freezing.

Two York vertical single-acting ammonia compressors with 10-in. by 10-in. cylinders, direct-connected to two 125-hp., 3-phase, 60-cycle, 2300-v. Fairbanks-Morse synchronous motors operating at 360 r.p.m. supply 200 tons of refrigeration—2000 lb. per 100 sq. ft. of ice. Provision for the low initial starting torque developed by the synchronous motors makes possible starting of the compressors with full opening on suction and discharge stop-valves. Capacity and power consumption are reduced in almost exact proportion to refrigeration load, regardless of operating speed.

So little refrigeration is lost during the graveyard shift — 11 p. m. till 7 a. m. — that it is possible to shut down the power plant during this period most of the year. A compressor is started at 7 a. m. and by 9 o'clock the ice floor is ready for skating. During the noon hour the ice is scraped and "snow" shoveled into a melting-box from which water afterwards is removed by a sump-pump. Water is hosed onto the floor for a new film of slick ice, which is ready for skating by 1 o'clock. This operation is repeated from 5 to 7 p. m. and the rink closed at 11 p. m.

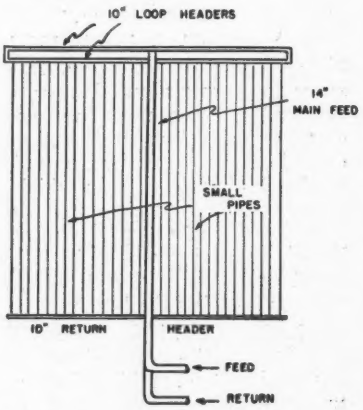


Fig. 2. Diagram of the brine circulating system

An 8 by 8 standby compressor may be added if summer nights become hot enough to render such additional equipment necessary. This machine will be entirely automatic, operated by thermostatic control.

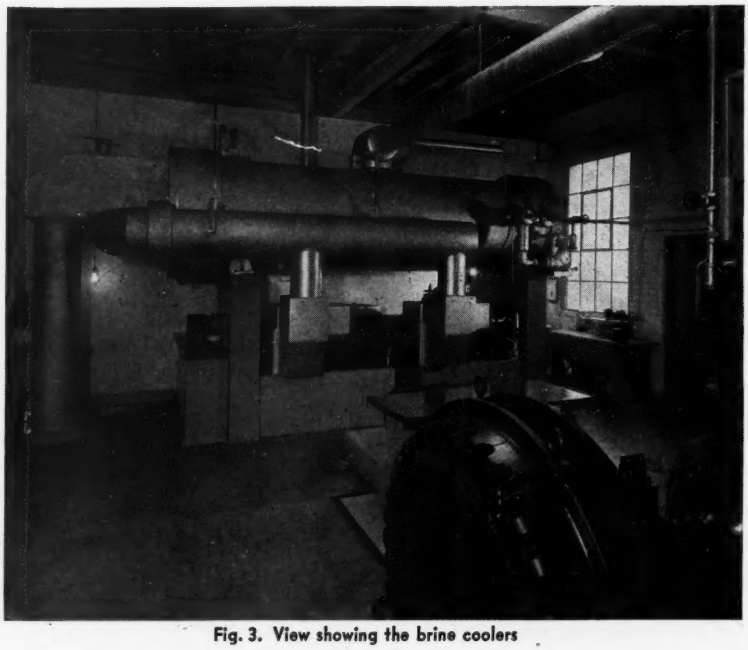


Fig. 3. View showing the brine coolers

Two 500-g.p.m. condenser pumps are direct-connected to 10-hp. induction motors operating at 1750 r.p.m. Bear brand anhydrous ammonia is used.

Brine is cooled by two 16-ft. by 30-in. horizontal multi-pass closed-type shell-and-tube ammonia condensers insulated with Corinco cork and supported by head-high concrete pillars. The entire 200 barrels of brine is forced through more than 14 mi. of pipes in 3 min., restoring the 1½-deg. drop in temperature, by two 1800-g.p.m. pumps direct-connected to 25-hp., 220-v. motors running at 1750 r.p.m.

The cooling tower is the forced draft type, with redwood louvres, and reduces the temperature of 1000 gal. of water per min. 6 deg.—from 82 to 76—under optimum conditions with 70 deg. humidity. The tower was placed upon the roof of the power-plant to save space and is entirely enclosed with redwood walls.

The motors are painted blue, balance of equipment aluminum.

The refrigeration machinery is York; pumps and motors, Fairbanks-Morse; plumbing, Crane; cooling tower, Marley.

Cliff and Phil Henderson operate and partly own the Pasadena rink and a similar one in Hollywood. They formerly promoted the Cleveland auto races, now devote all their time to the cold weather sport of ice skating in semi-tropical Southern California, made possible by the modern marvel of refrigeration machinery.

Safety Records

ALL-OUT production and soaring employment have not necessarily meant increased accident rates in companies which have broad, fundamental safety programs, the National Safety Council reported recently. The 1940 fatality rates of companies reporting to the Council were 2½ per cent below 1939, indicating that safety-conscious companies have been able to take employment increases in stride.

Industrial injury frequency rates averaged exactly the same, and the severity rates showed a 1 per cent drop. This is a bright spot in the picture for the nation's industry as a whole, according to Council estimates. The national occupational death toll in 1940 for all industries and occupations is estimated at 17,000—a 10 per cent increase over 1939. With total employment up 2 or 3 per cent in 1940 and manufacturing employment up 6 per cent, the national fatality rate on an exposure basis probably increased about 7 per cent.

The effect of the defense program, however, was apparent in some company records reported to the Council. But many of the industrial classifications most heavily burdened by defense activities had rate reductions. Thirteen of the 30 major industrial classifications showed decreases in frequency rates, 15 had increases and 2 remained unchanged. In 17 of the 30 industries, 1940 severity rates were lower, in 12 they increased, and in one it was unchanged.

Piping Inspection Demanded Under Defense Loads. II

In Part I of this two part article, the outline of piping inspection procedure was given and points of the unit hook-ups to be checked were indicated. This installment deals with main and branch piping and fittings, calling attention to many features that need checking

AFTER the unit hook-ups have been inspected in the various departments, the mains and branches leading to and from these departments should receive attention, bearing in mind that where faults have been found in the service to units the offending condition may lie in the supply line, particularly if two or more units served by the line experience the same trouble. Thus defects may be located by the process of elimination.

First give consideration to the anchors and supports of the main piping to see that they are functioning properly and keeping the piping in proper alinement and pitch. Evidence of movement from their original positions or breaks due to excessive strains warrants a complete checkup of alinement. If a pipe is not actually riding on the roll support, or if hangers are not carrying their proportion of the load and permitting the necessary movement, correction in alinement is definitely needed.

One of the most serious strains placed upon the piping system is that due to vibration. This may be caused by the operation of the apparatus which it serves, by the pulsating flow of the fluid in the piping, by water hammer, or by vibration of the supporting structure. Pipe vibration may cause almost every defect to which piping is subject—destruction of joints, valves and fittings, crystallization of piping metal, injury to instruments, breakage of supports, unsatisfactory operation of many machines, cracking of masonry walls, injury to pipe insulation. It becomes extremely costly if not checked. Inspect the pipe covering for evidence of cracking, also the walls about supporting brackets, then test the line and building structure for vibration which cannot be detected by hand. To detect the cause is not always easy, but instruments are available that give the frequency of vibration and these are helpful in identifying an offending engine, pump, fan or turbine. Where water hammer is the cause, study the piping system for undrained condensate pockets in steam and air lines, and uncushioned dead ends in water lines.

Main and branch lines are subject to leaks the same as service hook-ups, the importance of these leaks, however, is greater since these lines are nearly always in continuous service and the fittings affected are, in general, larger. Leaks through stuffing boxes, if prolonged, cause damage to the valve stems and those past gaskets are injurious to the face of the joint, to tolerate them is an inexcusable expense for they are easily detected by a plume of steam, dripping of water or other liquid, a hissing of air or gas. Stopping leaks at joints can usually be accomplished by taking up or regasketting the joints, at valve stems repacking is the usual procedure,

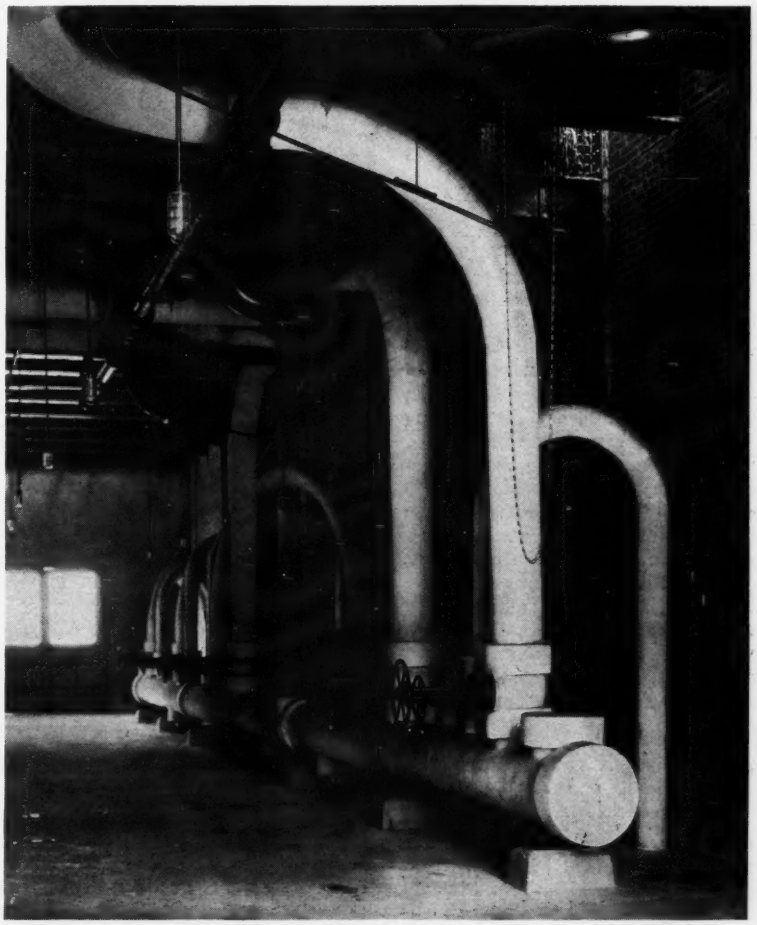


Fig. 4. Each detail in the design of piping is provided for a specific purpose, a check-up on the supports may indicate unprovided-for strains in the pipe bends

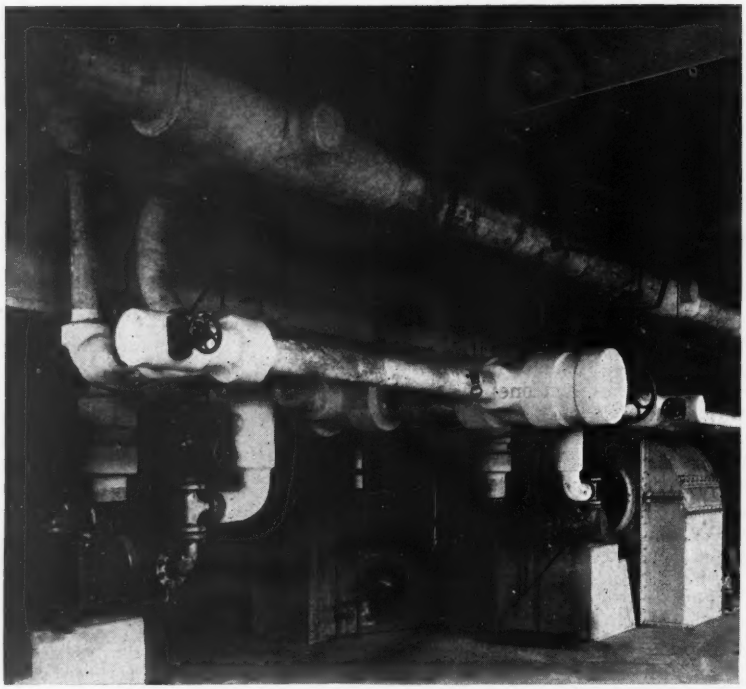


Fig. 5. Steam driven power units require careful protection from condensate in supply piping

but if this fails a cracked valve stem or warped valve body may be the cause. A wet spot on the pipe covering or on the floor beneath a pipe line should have the cause investigated.

Leaks underneath pipe covering are particularly destructive to piping because of their corrosive effects and the fact that they may exist for an indefinite period unnoticed by the attendant. Some inspectors suggest puncturing the covering with a sharp wire at suspected points, thus permitting the leakage to escape and be detected.

When steam or other fluid leaks past the seat of a closed valve one or more of several conditions may be the cause: Seats or discs may be scored, piping may be out of alinement, expansion and contraction strains may exist, vibration may be excessive and cause valve leakage by releasing stem threads, corrosive action may be present, dirt or other foreign solids may be in the line. Each of these causes should be investigated if the defective valve does not hold after ordinary means have been taken to see that the valve disc and seat are in good condition.

In factories where war equipment is being manufactured many changes have had to be made to shift over from peace-time products to those used in war and with the tooling-up that has been necessary the service of main and branch lines may have been changed considerably. Pressures and temperatures may have been stepped up without adequate provision for additional temperature strains or increased heat radiation, even piping and valve materials may not be best suited for the new conditions, pipe and valve sizes need investigation.

Conditions like these may not show up as dangerous for some months after they are put into service, but they are continuously wasteful of heat and power as well as destructive of piping equipment. During the inspection, therefore, it is advisable to ascertain exactly where and when increases or decreases of any conditions have been put into effect, then follow through the entire system to ascertain just what parts of the piping have been affected. Particular attention should be given to expansion provisions, alinement, condensate removal, pipe covering, piping and valve sizes, piping and joint materials, packing and gaskets.

Changed conditions are frequently severe on expansion joint service, demanding a greater range of operation than it has been performing in the past or perhaps beyond its design provisions. The inspection should include an examination of every expansion joint to make certain that it is not binding or cramping, that it is adequate for the conditions of service, that the stuffing boxes do not leak, and that the materials used in the construction of the joint are suitable for the temperature conditions of the service. Consider the advisability of substituting expansion bends for expansion joints.

Condensate Removal

Steam and compressed air piping must also be provided with means for removing the water of condensation which precipitates out of the vapor or gas, improper or inadequate handling of condensate is one of the most expensive of all piping wastes. When it accumulates in low places or pockets in the piping system, it restricts the working area of the pipe, causes water hammer, induces corrosion and is often charged with erosive action when carried along at high velocity with the steam or air. The inspector, therefore, should determine the location of all the low points in the system where condensate may collect, make sure that automatic means are provided for draining these points and that this equipment is functioning properly, he should then examine all valves in vertical lines to see that condensate is automatically removed from above the valve. Failure to provide means for removing condensate is a frequent cause of damage to equipment due to slugs of water.

When checking up on condensate provisions make certain that all drip pockets and separators are provided with water gages to indicate the accumulation of condensate, there should be no accumulation if traps are operating properly, also see that steam traps are provided with test valves ahead of the trap, these should blow clean steam if lines are clear and traps functioning properly.

When drainage is not adequate, equipment using steam for heating purposes is likely to be slow in heating up, unable to come up to rated capacity or fail to maintain temperature to the desired point. All of these unsatisfactory conditions should be investigated and the traps draining the apparatus should be checked for capacity rating.

Condensate from steam piping should be hot or at least very little lower in temperature than the steam from which it is condensed or the material being heated in an

exchanger. It is wasteful to allow this heat to escape for it can serve a good purpose in raising the temperature of the boiler feedwater. When the condensate is pure water it should be returned directly to the boiler, when contaminated the heat may be reclaimed in some sort of closed heat exchanger.

Condensate is valuable and it should not be allowed to drain to a sewer or to atmosphere. To prevent the escape of heat, drip piping should be thoroughly insulated and the condensate delivered as quickly as possible to the boiler or heat exchanger. In many cases, oil separators will sufficiently purify exhaust steam so that it can be used

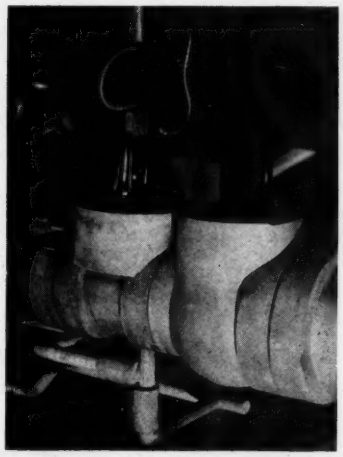


Fig. 6. Remote controlled valves are machines that require special attention

in open feedwater heaters and thus not only save the heat but the water itself.

Valves and Fittings

Valves and fittings have been developed and standardized for nearly every conceivable service for which piping may be used. Many advancements in design and materials of construction have been made during recent years and an inspector of the piping system should indicate the types of valves that are installed in order that their applications can be checked against recommended service. Too often selection has been made on the basis of pressure, temperature and fluid handled without reference to the special characteristics of the work to be done.

Globe valves, for example, should be used where the service is of the throttling type such as for pumps, stokers, heaters, etc. They are less subject to destruction from vibration and cutting than gate valves and they are more easily repaired which is an important consideration. The sizes and the direction of flow should be checked. Globe valves, as a rule but not always, give best service when the pressure is on top of the disc, flow is thus only in one direction. Gate valves should be used either wide open or tightly closed and the flow can be in either direction, one application is for sectionalizing a main steam header.

Extreme care should be given to such important valves as the stop check valves on boiler leads, motor-operated valves used for remote control, large sectionalizing header valves, each one of these is a machine in itself and requires regular, periodic inspection and maintenance attention in order to make sure of its reliability. When making a thorough inspection of the system, the interiors of all such valves should be examined, giving particular attention to the condition of seating surfaces and discs and to evidence of how far the valve is opening. In the case of the stop check valve, if it is opening only part way it is too large for the service. Valves of this type should be equipped with open blow drains as a safety measure.

Too frequently piping systems have been planned without proper provisions for sectionalizing and with each added service this defect in design makes operation more difficult and increases system losses. The inspector should study this situation and indicate on his drawing all points at which valves are needed to permit cutting in or out each section of the system. Another important point is to make sure that unions are installed at all points where it may be necessary at times to remove sections of piping or disconnect apparatus.

As the work of inspection proceeds, notes should be kept on all needed repairs and replacements, faults found with the design features and points that need further consideration. On the working drawings, check the details that have been found in satisfactory working condition. With the notes and checked drawings as a guide the engineer can make his plans to modernize his piping system a department at a time so as to interfere as little as possible with plant production.

Industries of the country have made rapid progress in the tooling up process to meet the demands of the National Defense Program. In too many instances this work has been done without due regard to the existing piping system. It is time now to make sure that the piping system is adequate, convenient, safe and economical.

Grinding Coolants

As in all machining operations there occurs in grinding considerable generation of heat. If grinding accuracy is to be realized, a uniform temperature must be maintained throughout the work piece. To accomplish this, some form of cooling is essential, according to G. Russell Hersam of the Oakite Research Laboratories.

To illustrate the dependence of accuracy upon adequate cooling, consider a cylindrical grinding operation performed without any effort being made to cool the work. It is obvious that the heat generated will be greatest in the immediate area of the work in contact with the wheel at any given time. This localized heating causes greater expansion along the side which, at any instant, is against the wheel, and the work bends toward the wheel.

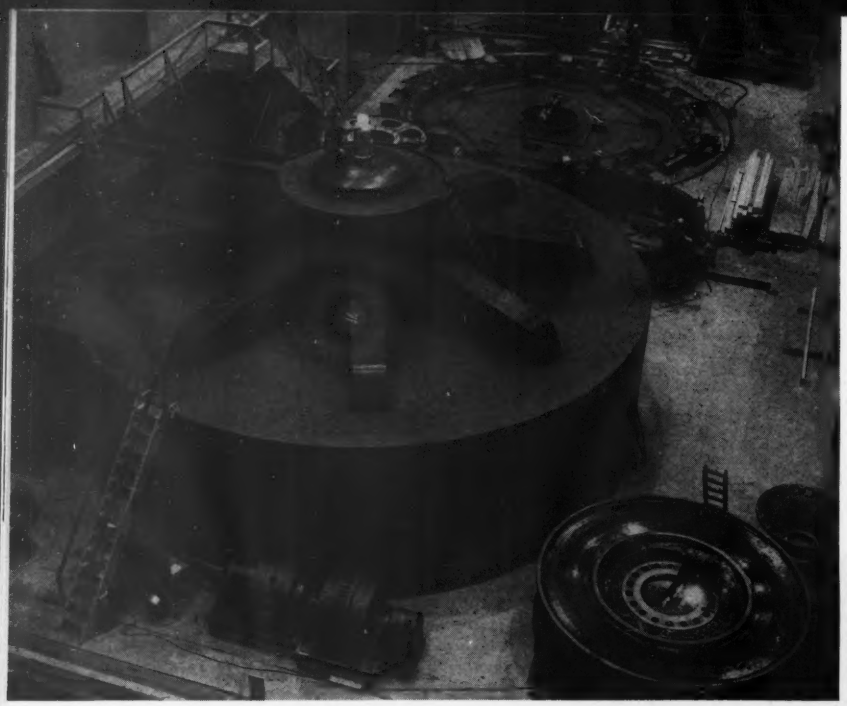
Since the work is in rotation, the distortion is continually changing. The axis of the work is continually changing also and the inevitable result is undersized work.

For the sake of accuracy steps must be taken to avoid this localized heating. It is customary to maintain the work at a uniform temperature by the use of a fluid which gives rapid heat dissipation. This fluid, or coolant, is directed in a large-volume, low-pressure stream onto the work and the wheel at their point of contact.

Among the coolants used today, water emulsions of soluble oils are probably the most common. The high water content of a soluble oil grinding emulsion acts effectively to give rapid cooling. The oil content serves in a rust preventative capacity and contributes towards securing finer finishes.

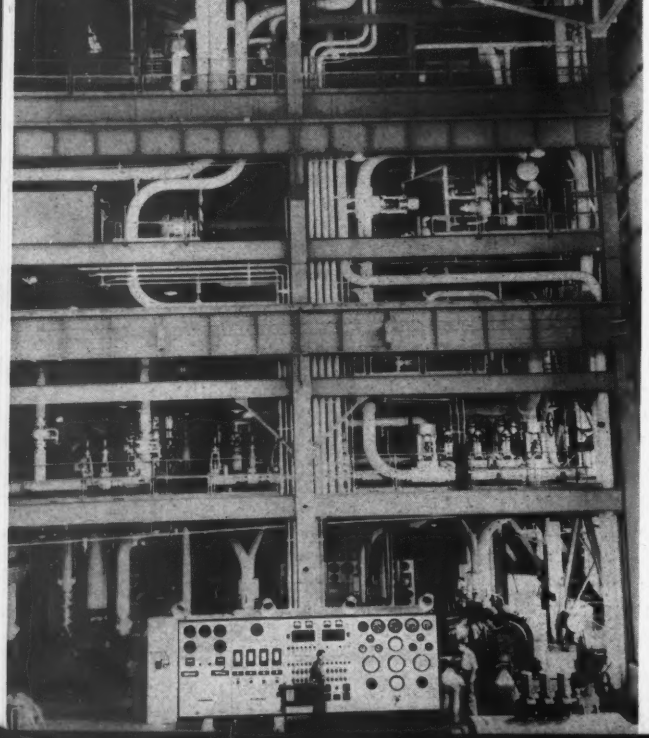
The important qualities which a coolant should possess may be considered as follows: provide efficient cooling; have rust preventative properties; not interfere with the grinding action of the wheel, but keep it clean and free cutting; assist in the attainment of fine finishes; cause no gumming of the moving parts of the machine; remain clean for a considerable length of time during use; have high resistance to rancidity; have no objectional odor; and finally should be economical to use.

PICTURES



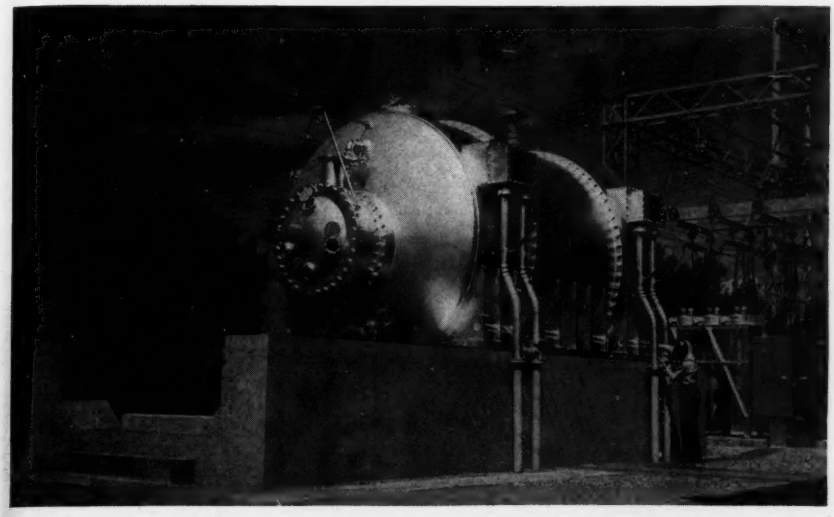
Over 1750 tons of copper, steel, iron, tape, and other materials make up the 108,000-kw. turbine generators being assembled in the west power house at Grand Coulee Dam. The first one of the 18 units to be installed in the two powerhouses has been completed. A motor generating set in the foreground driven by the station service generator provides the power for exciting the big machine. This exciter enables the field to be excited before the generator starts, allowing the 2—65,000 hp. irrigation pump motors to start simultaneously

Assembling the world's largest hydroelectric generators at Grand Coulee appears to be a happy job for these skilled engineers. Left to right they are: Sam P. Fisher, assembly foreman for Westinghouse Electric & Mfg. Co.; F. J. Malarkey, turbine erection engineer for the Newport News Shipbuilding & Drydock Co.; H. Walter Berkley, erection supt. for Westinghouse, F. A. Smith, erection engineer for the Woodward Governor Co.; and J. A. Kadletz, transformer erection engineer, General Electric Co.



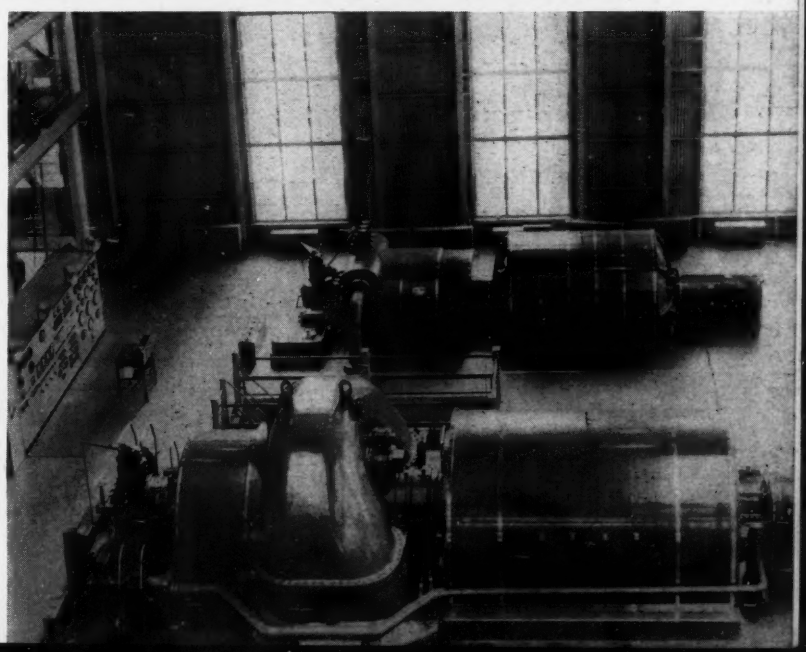
Left: A symphony of high-pressure piping. Hundreds of feet of special alloy steel piping required to withstand the extremely high pressures and temperatures at Twin Branch Station of the Indiana & Michigan Electric Co. near South Bend, Ind. Designed for an initial steam pressure of 2500 lb. per sq. in., the highest ever used in an electric utility generating station in this country, the new installation at Twin Branch is expected to set new records in performance. According to Philip Sporn, chief engineer of the Indiana & Michigan Co. and vice president in charge of engineering of the American Gas & Electric Service Corp. the new high pressure unit is consuming just about one pound of (11,500 B.t.u.) coal per kilowatt-hour. The view at the left shows the boiler and the control board. All high pressure piping was electrically welded. The turbine generator shown on the opposite page was built by the General Electric Co. It is a cross compound unit with an aggregate rating of 76,500-kw. The high pressure turbine which operates at 3600 r.p.m. uses steam at an initial pressure of 2300 lb. per sq. in., and a temperature of 940 deg. F. This steam is resuperheated to 900 deg. for the low pressure turbine operating at 1800 r.p.m. The resuperheating cycle is ideally suited to the design of this unit because it gives from one quarter to one third of maximum capacity to the high pressure unit

# of Engineering Interest



The view at the left shows the shining new 20,000 kv-a. General Electric synchronous condenser recently put in service at the Denver Terminal of the Public Service Co. of Colorado. This 13,800 v. machine, installed outdoors, is hydrogen cooled and operates at 900 r.p.m.

At the right is shown one of the latest installations made by the Westinghouse Electric and Mfg. Co., to control central station auxiliaries. This smoothly designed job is the 460 v. metal enclosed switchgear assembly recently installed in the Windsor Power Station of the West Penn Power Company. It consists of three sections, each section having a 4000 amp. main breaker, a 3000 amp. feeder tie breaker, and twenty 1200 amp. feeder breakers. These De-ion air circuit breakers are of the removable or drawout type to facilitate inspection and maintenance. The three sections are connected by metal enclosed bus runs



Right: A general view of the 76,500-kw. cross compound General Electric turbine-generator at Twin Branch referred to on the opposite page. The 3600 r.p.m. high-pressure unit is shown in the background. This high-pressure turbine embodies double shell construction. Maximum pressure in the first wheel casing of the inner shell is 1900 lb. per sq. in. at 910 deg. F. Maximum pressure in the space between the inner and outer shells at full load is 955 lb. per sq. in. with steam temperature between 750 and 840 deg. F. This construction divides the bolting loads between two rows of alloy bolts and the outer casing is not subjected to temperatures higher than those already experienced. Generators of both the high and low pressure turbines are hydrogen cooled, reducing losses considerably. Both cooling systems are connected to a common treating equipment for extracting hydrogen and air from the sealing oil, and are provided with condensate or service water as dictated by conditions

A Diesel Engine In the Spice Trade

A 300 hp. engine takes flood and long service in stride at Frank Tea & Spice Company plant

BY WILLIAM H. GOTTLIEB

AFTER 8 yr. of steady, unfailing service, a 300 hp. Worthington Diesel continues to supply all power for operation of the Frank Tea & Spice Co. plant in Cincinnati, Ohio, with an efficiency that equals, and in some respects surpasses, its original performance. Even a major flood could not damage this power plant.

A good deal of heavy machinery is required to prepare and package spices for market. The Frank Co., purveyors of peppers and spices since 1889, has built up a complete, self-sufficient plant. Their lithographing plant stamps trade marks and product descriptions in color on sheets of light metal. The can department transforms these sheets into containers of varied shapes and sizes. A number of presses print the cardboard boxes and paper labels. Grinding mills driven by 30 hp. motors grind the spices and peppers. Automatic filling machines fill and seal the containers. The entire plant, of course, must be lighted.

Diesel Unit Performance

For power to turn all these machines and supply the lights, the plant depends upon a 4 cylinder, 13½ in. bore by 17½ in. stroke, mechanical-injection Diesel rated at 300 hp. at 327 r.p.m. It drives, directly, a 200-kw., direct-current, General Electric Co. generator. The average load throughout the 9½ hr. working day is about 195 hp. or 65 per cent of engine capacity. It is not an easy load to carry for the grinding mills are turned on and off from time to time. No provision has been made to prevent the simultaneous starting of several mills and, consequently, the engine has to stand up occasionally under heavy overloads. As a protection to the power plant, an overload circuit breaker has been provided. If the overload comes on suddenly, this device kicks out at 850 amp. If the load grows gradually, the engine is permitted to carry 1000 amp. before the circuit breaks.

When the engine was put into service in January, 1933, it returned better than 12 kw-hr. per gal. of fuel consumed. In 1939, the average was 12.8 kw-hr.; in 1940, the figure was 11.9 with the heavy production month of December recording 13.09 kw-hr. per gal. Lubricating oil consumption during the first years of operation averaged about 1800 hp-hr. per gal. But an overhaul job in January, 1940, resulted in a remarkable improvement. Piston rings were renewed, oil holes enlarged and wrist-pin clearance increased. The results are shown graphically in the operating figures for the year, given in Table I. The crankcase was drained and filled with 35 gal. of new oil in January, and again in July. Including these oil changes, the consumption of lubricant for the year was 1 gal. for more than 3400 hp-hr. In the course of normal operation, no oil whatsoever is added to the crankcase. About ¾ gal. is supplied to the mechanical lubricators each day. Some of this oil runs down into the crankcase and the operator has found it necessary, periodically, to remove oil from the crankcase to maintain the desired level. No allowance for these deductions has been made in the figures cited.

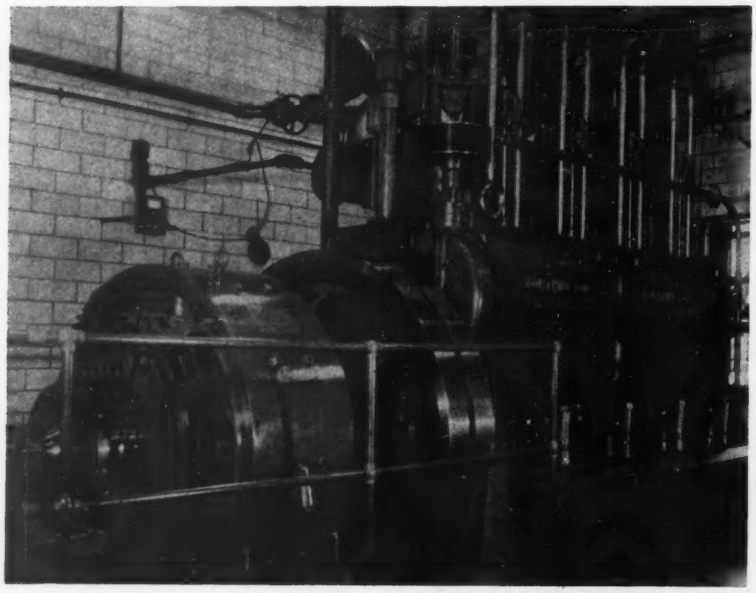


Fig. 1. This 300 hp. Worthington Diesel has been supplying all power requirements of the Frank Tea & Spice Co. for 8 yr. The d.c. generator is direct-connected. The exhaust pyrometer can be seen on the wall behind

Cost of Operation

In terms of costs, the Diesel has been paying dividends. Fuel oil at 4.8 cents per gal. cost a total of $1169.57 for the year 1940. Lubricating oil at 65 cents per gal. cost $140.72 for the year. With production at 289,824 kw-hr., the combined cost of fuel and lube oil was 4.5 mills per kw-hr. Company officials assert that total costs including fuel, lubricating oil, labor, maintenance, insurance and depreciation (at the rate of 10 per cent a year) amount to 9.6 mills per kw-hr. This compares to a pre-Diesel power cost of between 2.5 and 3 cents. Using the lower figure for comparisons, the company figures it has made an annual profit of more than $4500 from its Diesel operations. In less than 2 yr., the entire cost of the plant will be written off and the annual profit will be increased materially.

The engine has given such striking evidence of its durability that there is little question that it will

be operating with unimpaired efficiency for many years to come. After its installation in 1933, the Diesel was run for 3 yr. without pulling a piston or inspection. In 1936, although there had been no signs of trouble, Engineer Chris Foglesong decided to take the engine down for inspection. The greatest wear was 0.003 in. on the piston skirt. There was no measurable wear on the crankpins. The piston rings appeared to be in good condition and were put back into service. The next overhaul came in January, 1940. Maximum liner wear in 7 yr. was 0.012. Here are the micrometer readings on No. 3 liner which is representative:

Total Measurement

		Wear
Top Cross	13.262	0.012
Top Length	13.255	0.005
1 ft. Down Cross	13.253	0.003
1 ft. Down Length	13.252	0.002
Bottom Cross	13.251	0.001
Bottom Length	13.251	0.001

There was still no need for adjustment of any of the bearings.

Through a Flood

On January 28, 1937, the engine was treated as no engine should be treated. Flood waters invaded the plant, rising to a height of more than 8 ft. in the engine room. Muddy water engulfed the engine leaving only the valves at the top clear. When the waters finally began to recede, Mr. Foglesong hooked up a powerful hose and washed the mud off the engine and out of the room. When the crankcase was opened, it was found that the frame had been tight enough to filter out the mud and the water inside appeared perfectly clear. The water was drained, the crankcase and all lines flushed with fuel oil. A light lubricant was put in and the engine was run without load for a few hours. Then the regular lubricating oil was put into the crankcase and the engine was ready for return to service. No pistons were pulled; no bearings removed. The generator required sterner treatment. A housing was built around it and a heater put in to dry out the wiring.

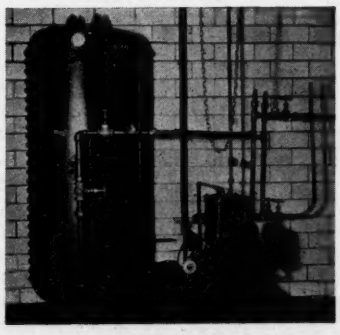


Fig. 2. A gasoline engine drives the starting air compressor. The storage tank is filled to 250 lb. pressure once a week and that suffices for all starting

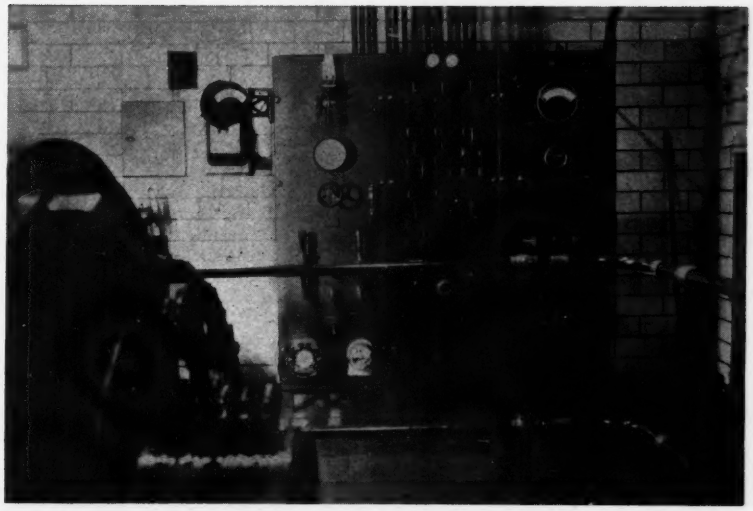


Fig. 3. The General Electric switchboard holds, in addition to usual instruments, an overload circuit breaker

The fact that the engine has run for years and weathered a flood without overhaul does not mean that it goes without attention. Operating and maintenance schedules were carefully devised and are followed religiously. The lubricating oil, which is supplied to the bearings under pressure by an engine-driven pump, is passed through a filter before reaching the engine. A centrifuge arranged for continuous operation, takes oil from the sump in the crankcase, cleans and returns it to the sump. Samples of the oil are tested periodically, and the crankcase is drained when the oil shows deterioration. A complete new charge of oil usually is put into the engine about every 6 mo., the equivalent of 1250 hr. of operation.

Fuel Handling and Operating Routine

Fuel is purchased according to specifications and a sample from each shipment is submitted to laboratory analysis. Fuel is stored in a 12,000 gal. tank at the company's 5th Street plant and is hauled in drums to the 4th Street plant where the Diesel operates. Here it is stored in a 600 gal. tank inside the plant but just outside the engine room. A motor driven transfer pump forces the fuel up to a 175 gal. tank overhead in the engine room and from this point it flows by gravity through a filter to the individual injection pump for each cylinder.

Combustion air is drawn through a two-element, impingement-type filter placed on the roof of the plant. Cooling water is circulated through the engine jackets and up over an atmospheric cooling tower by a centrifugal pump belted to the engine. City water is used for make-up. Exhaust gases vent through a vertical silencer. The

Fuel and Lube Oil consumption of Diesel unit

Month 1940	Kw-Hr. Generated	Fuel Consumed Gal.	Lube Oil Consumed Gal.	Kw-Hr. per Gal. Fuel
January	26,607	2,223	39.25	11.96
February	25,273	2,118	11.25	11.93
March	25,135	2,041	11.00	11.33
April	22,725	1,908	14.25	11.91
May	23,270	2,024	14.25	11.49
June	20,825	1,855	13.50	11.22
July	20,417	1,751	13.75	11.66
August	18,851	1,652	44.75	11.41
September	21,024	1,778	17.00	11.82
October	29,427	2,458	16.00	11.97
November	28,924	2,317	13.25	12.48
December	29,346	2,241	8.25	13.09
				Average
Total	289,824	24,366	216.50	11.89

operators like to know what their plant is doing and use their exhaust pyrometer, thermometers, pressure gages, demand meter and watt-hour meter to further their knowledge.

For starting the engine the plant contains an air compressor driven by a 6 hp. gasoline engine, and a 30 by 60 in. storage tank. This tank is filled to 250 lb. pressure once a week and suffices for starting all week.

The maintenance schedule calls for the grinding of exhaust valves every 6 mo., and inlet valves once a year. The spray nozzles are cleaned every 6 mo. though the operators have never yet found one choked up.

For more than 8 yr. the Frank Tea & Spice Co. has placed full

FRANK TEA & SPICE CO.
ENGINE AND ACCESSORY EQUIPMENT

Engine—One 300 hp., 4 cycle, mechanical-injection 4 cylinder, 13¼ by 17½ in. Diesel, Worthington Pump & Machinery Corp.
Generator—One 200-kw., 250 v. d.c. generator. General Electric Co.
Fuel Storage Tanks—12,000 gal. and 600 gal.
Fuel Supply Tank—175 gal.
Transfer Pump—Deming Co.
Fuel Filter—Cuno Engineering Co.
Injection Pumps—American Bosch Corp.
Lubricating Oil—DTE Extra Heavy, Socony Vacuum Co.
Centrifuge—Hydroil.
Cooling Tower—Cooling Tower Co.
Water Pump—Worthington Pump & Machinery Corp.
Air Compressor — Worthington Pump & Machinery Corp.
Exhaust Pyrometer — Alnor, Illinois Testing Laboratories, Inc.
Switchboard—General Electric Co.
Overload Circuit Breaker — General Electric Co.
Watt Hour Meter—Sangamo Electric Co.

dependence in its Diesel plant. There is no standby service except a 10 amp. line for emergency lighting. In all those years the plant has had but two forced shutdowns totalling 3 hr. and 45 min. The 3 hr. halt was caused by the breaking of a rubber gasket at the bottom of a cylinder liner. In the overhaul last year, the engine was equipped with composition gaskets specially resistant to deterioration—a type now standard on Worthington engines. The 45 min. shutdown occurred when an exhaust valve stuck. Satisfied with its record of economy and dependability, the Frank Tea & Spice Co. is standing pat on its Diesel plant.

REFRIGERATING ENGINEER

Part XI

This installment of the Refrigerating Engineer is unusual for its entire lack of love interest. June Coldfax is not even mentioned and our industrious young hero is so concerned with his purging operation that he doesn't even have time to think about her. Don't let June Coldfax's absence stop you from reading this article, however. If you want to know how to go about purging a refrigerating system, Frosty Coldfax's methods can give you many useful pointers

BY GEORGE HOLMAN

EVER SINCE you have been on the job at the Wholesome, you have noticed that the temperature of the ammonia gas going to the condenser varies widely. Sometimes it is as low as 110 deg.; sometimes as high as 200 deg. This puzzles you at first. But one day you think of the reason, and feel ashamed of yourself for not thinking of it sooner. The gas is always cooler when Andy or Allen is pulling ice. When the can dump is horizontal and the spring-loaded valve open, the water can flow through the desuperheater and cool the gas on its way to the condenser. When the can dump isn't working, the desuperheater isn't working either.

You decide that the desuperheater should be working, whether the can dump is or is not. You dismantle the water line between the desuperheater and the dump, and insert a tee in it. From the tee you run a line down into the condenser drain pan, and place a valve at the end of the line within easy reach. When pulling ice, Andy and Allen can close the valve and send the water to the dump. When not pulling ice the valve can be opened to let the water circulate through the desuperheater, and thus help out the condenser.

Off With the Heads

Taking the heads off the desuperheater, you find 32 tubes, all of them filled with scale and rust blisters, and some badly corroded at the rolled in ends. You have no tube cleaner of the right size for those tubes, but make one from an old file, and partly flattening a piece of pipe for a holder for your cleaner. You do not shut the compressors down to clean the desuperheater and install the improvement in the line. And while you are making your cleaner, the tubes dry out and the rust blisters explode.

After cleaning the tubes, you scrape, wire-brush and paint the tube ends with red lead before sealing the desuperheater. On turning the water through the vessel again, you find that the temperature of the ammonia gas to the condenser never exceeds 130 deg. By continuously circulating the water through the desuperheater you have reduced the gas superheat by 50 deg. and removed that much of the load from the condenser.

You decide that you are now ready to purge that air, and ask Frosty to come over and give you the dope on how to do it rightly.

The Purge Begins

Frosty comes and takes over the purging operation. "First thing you do is to get this in mind," Frosty says, "Purging without an automatic non-condensible gas purge is a different operation than purging with one. Here you've got to purge by hand valve. The first thing we will do is close the master liquid stop valve, which shuts off all the liquid to the tank coils and cooling room coils, and leave the machines running until we pump out the system down almost to zero. Pumping out the system may seem to have nothing to do with purging air, but you'll see later on that it does influence it quite a bit. For pumping out the low-pressure sides of the system—or low-pressure systems, if you want to call them that—will fill the liquid receiver, and perhaps the lower part of the condenser, with liquid refrigerant. If the liquid level rises in the condenser, the capacity of that vessel will be reduced. But with the suction pressure falling with the pumpout, less and less gas will be delivered to the condenser for condensation. As the suction pressure falls, the input of gas to the condenser from the compressors should just about continuously equal the output of liquid from the condenser with the decreasing capacity. But here is the important point: While condensation of the ammonia gas pre-

vents a partial pressure rise of that constituent in the mixture of gases in the condenser and receiver, the rising level of the liquid compresses the non-condensible gases, and raises their partial pressures, and of course, the total pressure per square inch in the system."

At the top of the condenser is a ½-in. valve on the end of a long nipple. Outside the valve is another long nipple. From the outer nipple a hose runs into a gallon bottle setting on a small shelf on the wall. The bottle is filled with water. You have had enough experience with ammonia to know what the water is in the bottle for.

Before the suction pressures fall to zero, Frosty tells you to shut off the compressors. "Never pump any part of a refrigerating system out to sub-atmospheric pressures, unless it is absolutely necessary," he advises. "Reversing the pressure on the valve stem packing is likely to cause leaks around the stems."

You climb to the top of the condenser. "There are people who will tell you that purging should be done very slowly," Frosty says. "And there are books which give the same advice. But the slowest way is not the correct way to purge. Of course, you should not open the valve so widely that the rapid fall in pressure will cause the liquid ammonia lying in the receiver and in the bottom of the condenser to boil violently, or for ammonia gas to blow out through the water in the absorbing bottle before the water can absorb it. For as you purge the mixture of ammonia gas and non-condensible gases, the pressure upon the liquid ammonia falls, and evaporation of the liquid begins. The gas freshly formed by evaporation rises and diffuses into the mixture of gases above it. If purging takes place more slowly than diffusion, some of the freshly evaporated gas will be purged, and the loss of refrigerant increased. The golden mean of purging is to purge at the same rate of speed as evaporation without the turbulence of rapid boiling.

"Many engineers forget that the pressure drop which may start the liquid to boiling violently will not be the total pressure drop, but only the partial pressure drop caused by the loss of the ammonia gas constituent of the mixture of gases being purged. If the purge valve is opened, say one full turn, and left that way until purging is complete, the total pressure will fall in a steadily decreasing ratio as the pressure differential between the total pressure and the atmospheric pressure decreases.

"But the partial pressure of the ammonia gas constituent of the mixture will be maintained by evaporation of the liquid. Regardless of the total pressure variations, the partial pressure of the ammonia gas will remain constant at the pressure corresponding to the saturated ammonia pressure at the temperature of the water circulating through the condenser. No ammonia gas will rise to take the place of the non-condensible gas being purged, but only to take the place of the ammonia gas being purged with the non-condensible gases. Of course, some diffusion of the freshly evolved ammonia gas with the mixture of gases will take place, even in a short while. But the longer the purging time, the more diffusion will take place, and the more ammonia gas must be lost to get at the non-condensible gases. This is why purging should take place as rapidly as possible without the partial pressure drop of the ammonia gas constituent setting up enough turbulence of ebullition to agitate the constantly rising diffusion line."

Non-condensible Gases

"When am I to know when there are no more non-condensible gases in the system?," you ask.

"By the sputtering of the almost pure ammonia gas as it is absorbed by the water, and by the increase in temperature of the aqua formed by such absorption," Frosty tells you. "And also by the lack of non-absorbable gas bubbles rising from the submerged end of the hose to the surface of the aqua in the bottle. That bottle is too full. Empty it, and fill it with cold water. About three-fourths full. On combining with ammonia, the water gains in volume as it changes to aqua ammonia. You must leave room for the expansion."

"One of these so-called automatic non-condensible gas purges works differently than hand purging does," Frosty goes on. "Unless you have a pretty big system or a large group of systems, it is better to operate an automatic purge only when needed, instead of all the time, as the directions on some of them imply. It is just as foolish to operate, or to try to operate, a non-condensible gas purge when there are no non-condensible gases in the system as it would be to operate that sharp freezing compressor after the goods in your freezer are all frozen and the temperature there down to normal."

"The method of purging air with an automatic non-condensible gas purge will depend on whether the purge connects into the condenser or into the liquid receiver. Assuming that it is on the liquid receiver, from the upper part of which the mixture of gases is drawn and into the lower part of which the condensed liquid returns, purging should be done with all compressors in normal operation. They should not be shut down, as we have done here. The only change made should be to close the valve on the liquid line from the condenser. This will hold the condensing liquid in the condenser, at least until the liquid level rises to the place where the equalizer line taps in. The rising liquid level in the condenser and the fresh gas coming into the condenser from the compressors will drive the non-condensible gases through the equalizer line into the upper part of the liquid receiver. The level of the liquid in the receiver falls. The gas space in the receiver increases, and is filled with the non-condensible gas mixture being driven out of the condenser. So by the simple act of closing the liquid stop valve from the condenser, the mixture of non-condensible gases is brought right up to the intake of the purge."

Checking the Gages

The purging done, Frosty places a thermometer in the well in the liquid line from the condenser. "While we're at it, we'll calibrate the discharge gages by thermometer," he says. "That is, we'll set the gages at the saturated ammonia pressure at the temperature of our cooling water. I'm glad that the water temperature and the dry bulb temperature of the atmosphere are nearly the same. For gages cannot be accurately set when the condenser cooling water is colder than the dry bulb reading of the thermometer. And here's why: The liquid ammonia in the condenser close to that thermometer well may be colder than the liquid ammonia at some other part of the high-pressure system where that part of the system is surrounded by air or other substance at a higher temperature than the cooling water is. For the

vapor pressure of any refrigerant will always be that corresponding to the saturated pressure of the warmest liquid in the system, never the colder or coldest, and regardless of where that liquid lies so long as it is not isolated by valves."

"It is true that with a fall of its own vapor pressure upon it, the liquid phase of a volatile substance will combine with some of its heat content, or with any acquirable heat, and pass over into the vapor state, that is, cooling itself. And as long as it can acquire heat from its surroundings, it will continuously try to build up its own vapor pressure. To cite a concrete example of what I mean, gages should not be set when bubbles rise in the gage glass of the liquid receiver. For such bubbles are a sign that the liquid in the receiver is in process of evaporation, and that the vapor pressure upon it is slightly greater than the vapor pressure maintained by the cooling water in the condenser. There will be a pressure drop across the equalizer line between the receiver and condenser, and the circuit will be completed by the vapor condensing in the condenser and returning by gravity to the receiver. In plainer words, the refrigerant takes up heat from the higher temperature air of the room. Such heat passes through the walls of the receiver, rises with the vapor to the condenser, and passes through the heat transfer surface to the cooling water."

"Some other things about setting gages are these: See that the valves to the gages are wide open, for gages must often be throttled to control vibration and the pulsations of gas leaving the compressors. And where a pipe turns downward to a gage, as is the case with all three of these, allow a 1 lb. permissible higher reading for each 4 ft. of vertical pipe above the gage. For such vertical pipes running downward to the gages may be full of oil or liquid ammonia, either of which will add its weight to the gage reading at approximately 1 lb. for each 4 ft. of height above the gage."

Only one of the gages requires resetting. After shifting the hand on it, you ask, "What about the suction gages?"

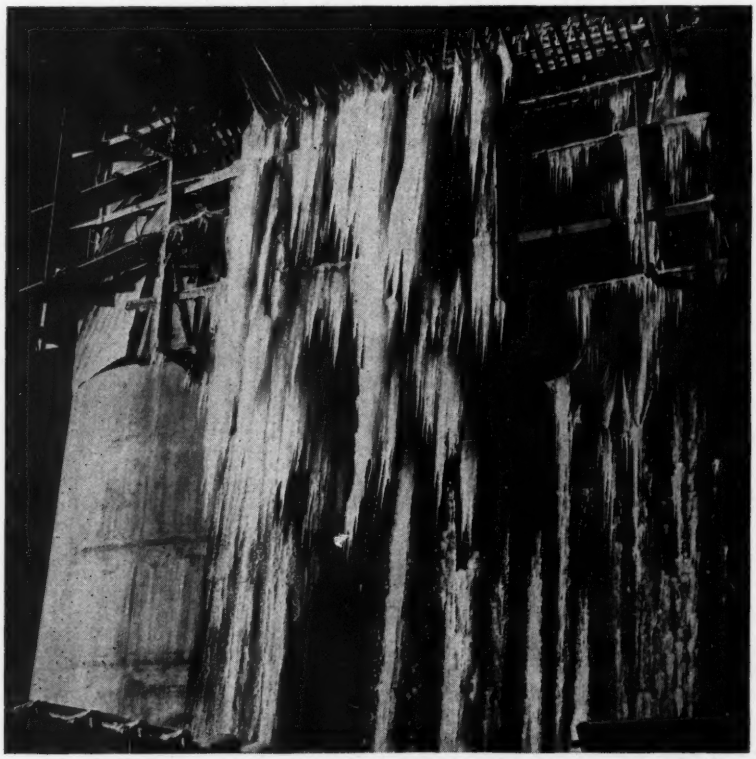
"They can be easily calibrated at atmospheric pressure by closing the valves on the gage lines and opening the lines at the flange connections. Of course, any gage may be calibrated on a test set. And if you care to, you can use ours from the Aurora. We use steam gages there also, and calibration of steam gages on a test set is mandatory."

Fifty Below Zero!

"Another thing," you comment. "The other day when blowing down oil from the cooling room accumulator I accidentally drew off some liquid ammonia. I was surprised to see that it floated on the oil in the can. But I was more surprised when I put a thermometer in it. The reading fell to fifty below zero. It has me puzzled. The red figures on these gages we just set and the tables in my book of refrigeration both show that the temperature of liquid ammonia at atmospheric pressure is –28 deg. What did that ammonia I drew out of the accumulator have in it to cause it to drop more than 20 deg. lower than it should have?"

"Nothing," Frosty answers, then explains: "like the use of a sling psychrometer or hygrometer, that is merely another manifestation that Dalton's Law of partial pressures is a true one. Evaporation of liquid ammonia, just like the evaporation of water, is governed by the pressure of its own vapor upon it, and not by the pressure of air or some other gas. If the vapor formed by evaporation is rapidly removed from the liquid, more vapor will form, even if the liquid must use its own heat in order to evaporate. While this vapor so formed will slow up evaporation when held next to the liquid by air or other gases until it has time to diffuse into such air or other gases, evaporation can be accelerated by passing a current of air over the liquid, thus removing the vapor as fast as it forms. The result will be a rapid removal of heat, more rapid evaporation, and a lower temperature. Bear this in mind: Ammonia liquid has a temperature of 28 deg. below zero only when it has a pressure of 14 7/10 lb. per sq. in. of its own vapor pressure upon it, no matter if the air pressure is one atmosphere or a hundred. Whenever the ammonia vapor pressure is only partial, the liquid temperature will fall below minus 28 deg. The temperature of the liquid will always equal the saturation temperature at that partial pressure."

(To be continued)



WHEN WINTER COMES TO GRAND COULEE DAM

This view is a reminder of conditions under which construction work was carried on last year during the installation of drum gates which regulate the upper level of the reservoir behind Grand Coulee Dam, a reminder that winter's forces are extremely powerful and return with only slightly varying magnitude year after year

Fuel Engineers' Conference

Better utilization of coal stressed at Easton meeting. Discussions centered around the technique of burning of different coals on stokers and in pulverized form

FOR THE fifth time in that many years, the Fuels Division of the American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers met to discuss problems of mutual interest having to do with the mining and use of coal. This conference took place in Easton, Pa., with headquarters at Hotel Easton, where most of the sessions were held, on October 30 and 31 with November 1 reserved for inspection trips to nearby industrial plants.

Nearly 300 engineers were in attendance and devoted their time almost exclusively to the various phases of the theme of the conference — Better Utilization of Coal. Some years ago these groups of engineers came to the realization that, with a better understanding of the problems confronting each other, satisfactory changes could be made in mining, marketing and burning coal with the result that mutual economic benefits would be derived.

These conferences have helped greatly in giving to the miners and coal distributors information on the needs of the consumers which has brought about decided improvements in the quality of coal. They have also imparted to coal consumers and designers of coal using equipment information regarding mining practices which has enabled them to specify more logically the quality of the coal they desire and to modify stoker and furnace design to fit more closely the quality of coal that could be expected from the dealer.

For this particular conference, the joint committee formulated a program designed to produce information that would be helpful in establishing a standard for measuring the performance of coal. Interest centered, therefore, around the symposium type of meeting where formal papers prepared from different viewpoints were presented and then followed by free-for-all discussions including questions.

Adjustment of Pulverized Fuel-Burning Equipment

"When change of coal becomes necessary or advisable in a pulverized coal installation," said Henry Kreisinger, "some of the properties of the new coal, indicated by proximate analysis, size and hardness of the coal, and the fusion temperature and composition of the ash, are likely to affect the operation of the plant adversely, and some changes in the operation or in the equipment must be made to offset any shortcomings of the new coal."

Some other pertinent statements he made were: "Handling and pulverization of coal is affected by size, moisture content and hardness of coal. The size affects the flow of the coal from coal bunker to the mill. If the coal contains too much fines, the coal may hang in the bunker, in the coal chute or in the mill feeder. The hanging is aggravated by high moisture content which is often present in fine coal.

"Hardness affects the capacity of the mill and power consumption per ton of coal pulverized. Many hard coals have high volatile matter content and need not be pulverized as fine as the softer low volatile matter coals. If a mill is short of capacity with hard coal, raising the temperature of the air to the mill 100 deg. F. may bring the output of the mill to the required capacity.

"With high moisture bituminous coal, air temperature of 500 deg. F. is desirable, and with lignites, air at 800 deg. F. and even hotter may be required. The air from the gas air heater may be hot enough at full load rating, but may not be hot enough at reduced ratings.

"High volatile coals ignite and burn quicker than low volatile coals. The extreme in the low volatile is the anthracite which must be dried to very low moisture content, must be pulverized to a high degree of fineness, and the air supplied with the coal to the furnace must be greatly reduced to obtain stable ignition.

"When change is made from high volatile to low volatile coal, the mills should be set for higher degree of pulverization.

"When change of coal in a pulverized coal installation is to be made a different behavior of the ash is likely to be encountered. Only by actual trial of the new coal can the ash behavior be known."

In considering changes in pulverized fuel from the standpoint of burning equipment, A. C. Foster indicated that the furnace design, location of burners, fuel characteristics—particularly volatile, ash, and moisture content—fineness of the pulverized fuel, primary and secondary air temperature all have their effect on the combustion of the pulverized fuel. Coal must be burned with a minimum of excess air without flame impingement on water cooled surfaces and with the combustion completed as soon as possible after the fuel enters the furnace, all of which requires rapid mixing of the pulverized fuel and air.

To these ends the designer of burning equipment has exerted his efforts with the result that two general classes of pulverized coal burners have been developed: one for anthracite and one for bituminous coals. Each of these classes has been modified into types to suit the particular pulverizing system and the furnace design. It was stated that the direct firing of pulverized, low grade anthracite is now as simple as direct firing of bituminous coal.

When burned in pulverized form, the principal differences to be found between coals were attributed by F. G. Ely to moisture, grindability, volatile and fixed carbon properties, and fusing characteristics of the ash. Physical arrangement of furnace and burners, type of cooling surface and facilities for the direct removal of slag and ash by mechanical blowers or hand lancing were spoken of as major factors in design which may be entirely suitable to the plant conditions and normal fuel but can be altered only at considerable expense. Load factor and the value of service availability often dictate the limitations on range of coal selection.

It was the opinion of Ollison Craig, whose paper was read by

F. G. Treat, that if a plant is located in a region where high volatile coal is most commonly available and if a change is made to low volatile coal, slower and less stable ignition and longer flame may be experienced when burning the coal in pulverized form. This is particularly true with cold furnaces. The result is to set a high limit on the minimum load that can be carried, experience some increased loss in unburned carbon and affect steam temperatures from the superheater.

If unstable flame is experienced, he stated, furnace puffs, or so-called explosions may occur, particularly at low rates of combustion. This comes about through inability of the flame to maintain ignition so that the flame periodically is extinguished, but later relights, when considerable quantity of coal has accumulated in the furnace. Ignition of this large quantity of coal builds up pressure faster than it can be relieved from the furnace, with consequences ranging from furnace pulsations to practical destruction of the furnace walls. Because of this unstable operation it becomes necessary to operate at higher minimum loads within a range where ignition can be maintained.

Underfeed Stoker-Fired Equipment

The symposium on adjustment of underfeed stoker-fired equipment, to which formal papers were contributed by George P. Jackson, J. S. Bennett and F. S. Scott, resulted in a session devoted to the descriptions of the various types of commercial underfeed stokers of large capacity and instructions for their operation with different varieties of coal.

On the straight line drive type of stoker, designed for severe duty, in which the stroke of each pusher may be changed without affecting the stroke of adjacent pushers while the stoker is in operation, Mr. Bennett said, practically all coals, whether friable or not may be burned effectively with the following reservations: (a) Anthracite gives poor efficiency and limited capacity, but mixing it with ⅓ or more medium or high volatile bituminous coal increases ignition and allows operating results nearly equal to 100 per cent bituminous coal. (b) Very low volatile bituminous coals burn satisfactorily provided sufficient grate area is available. (c) Coke breeze can be burned at low rates only unless mixed thoroughly with bituminous coal. (d) It is essential that the stoker and furnace shall be designed for the worst coals to be burned. Low fusion ash coals ordinarily require water walls.

The underfeed stoker, according to Mr. Scott, will handle a wide range of screenings direct from the mine operation, but it should have a fairly even size consist between the limits obtained. The best size of low volatile coals is such that 95 to 100 per cent will pass through a 2-in. round hole screen and 40 to 65 per cent through a ⅜-in. screen. The best size of high volatile coal is such that 95 to 100 per cent will pass through a 1¼-in. round hole screen and 40 to 65 per cent through a ⅜-in. screen. Midwestern coals give best results when 100 per cent will pass through a 1-in. round hole screen and 40 to 65 per cent through a ¼-in. screen. The limit of the amount of coal that can be consumed in a given time on a given area is the point at which the fuel bed will lift off the stoker in large amounts. This is not a fixed value. There is very little production of fly-cinder with underfeed stokers up to rates of about 40 lb. of coal per sq. ft. per hr. with eastern high volatile coal.

Burning Anthracite

In his discussion of the performance of anthracite on traveling grate stokers, J. H. Kerrick pointed out that the problems of ignition, stratification of gases, high carbon content of ash, high ash pit loss, fly-ash and other less important factors have been largely overcome through the combined efforts of stoker manufacturers, boiler manufacturers, furnace designers and the anthracite industry. Credit was also given to the field studies carried on by large users.

Stoker speeds in modern practice range from 40 to as high as 100 ft. per hour. No. 4 buckwheat is the accepted size range; the fuel bed thickness ranges from 1¾ in. to 2½ in.; burning rates from 30 to 50 lb. per sq. ft. of grate surface per hour are common practice; the front arch has entirely disappeared and has been replaced by a long rear arch.

Pennsylvania Power & Light Co., said C. H. Frick, is the largest single user of anthracite with an annual consumption for all purposes of 1,520,000 tons. In its power plants are 108 anthracite fired boilers; many of these are stoker fired, but three of the larger boilers are fired by pulverized anthracite and there are two larger boilers now on order also to be similarly fired, each capable of producing 365,000 lb. of steam per hour at 1325 lb., 930 deg.

Experimental use of pulverized anthracite in boiler plants began in 1918 and the results of research work carried on with this and other boiler units led, in 1927, to the installation of three large pulverized coal fired boilers in the company's Pine Grove plant. It was noteworthy, in his description of this plant and its operating results, that the overall boiler efficiency was increased from 75.1 per cent in 1931 to the highest point in its record of 83.8 per cent in 1937 due to a variety of improvements in the preparation of the fuel, modifications in furnace design and technique in handling the burning equipment.

During the conference two motion pictures in Kodachrome were used to visualize what happens in furnaces burning coal with stokers. One of these was a study of anthracite combustion in small retorts illustrating in a few minutes the changes in the fuel bed that take place during a week of operation under various conditions of draft and feed. The other picture showed combustion conditions, under various adjustments, in a multiple retort underfeed stoker fired furnace.

Papers Presented at the A.S.M.E.-A.I.M.E. Fuel Conference

Application of Chemistry to Anthracite Mine Fire Problems. O. W. Jones and C. S. Scott, U. S. Bureau of Mines.

Domestic Stoker Coal Research. Walter Knox and J. D. Doherty, Koppers Coal Co.

Symposium on Adjustment of Pulverized Fuel-Burning Equipment. Henry Kreisinger, Combustion Engineering Co.; A. C. Foster, Foster Wheeler Corp.; F. C. Ely, Babcock & Wilcox Co.; Ollison Craig, Riley Stoker Corp.

Symposium on Adjustment of Underfeed Stoker-Fired Equipment. George P. Jackson, Combustion Engineering Co.; J. S. Bennett, American Engineering Co.; F. S. Scott, Westinghouse Electric & Mfg. Co.

Effects of Changes of Moisture and Temperature on Mine Roof. I. Hartmann and H. P. Greenwald, U. S. Bureau of Mines.

Automatic Burning Control in Rotary Kilns. W. E. Reaser, Lafayette College.

Performance of Industrial Chain Grate Stokers. J. H. Kerrick, Philadelphia and Reading Coal & Iron Co.

Burning Pulverized Anthracite in Steam Power Plants. C. H. Frick, Pennsylvania Power & Light Co.

Better Utilization of Coal (banquet address), E. G. Bailey, Babcock & Wilcox Co.

PROTECTIVE RELAYING For Attended Power Plants

C. R. MASON
Central Station Engineering Dept.
General Electric Co.

WHY SHOULD YOU READ THIS ARTICLE?

You should read this article because it will benefit you to know more about the protective relaying in your plant. Protective relaying is not only a fascinating subject, but the protective relays themselves are your best friends when you need them most. And this article tells a story about relaying that you will enjoy and appreciate. Mr. Mason has done a fine job in presenting the subject in a simple, yet clear and forceful way and no matter how much you know or don't know about relays you will find his discussion worth while

WHAT IS A RELAY? In sports, a relay is a race in which each runner does his assigned task to the best of his ability, and then passes the baton to a team mate. Each runner is chosen for his own unique ability so that the team performs as no single runner could alone.

In engineering, a relay is a device whose function is like that of a runner in a relay race; it performs a portion of a certain task that it alone is most capable of doing, and then it passes on to another device the duty of continuing the sequence. The relay itself is simply a device having an actuating mechanism that responds to some predetermined condition, either electrical, thermal, or mechanical, to operate contacts in an electric control circuit. This circuit, in turn, controls the operation of some device in a power circuit.

The thermostat that operates to start or to stop your furnace is a simple relay, called a regulating relay. There are other types of relays, called auxiliary, control, and protective. It is the protective type that we are considering here, and particularly those various forms of protective relay involved in the protection of attended power plant electric apparatus.

Fig. 1. No monkey had any business being here

What is a Protective Relay?

A protective relay is a relay which trips a circuit breaker, or otherwise removes a piece of apparatus from service, when the apparatus suffers a short-circuit or any other abnormal operating condition that might endanger life, property, or service.

Why Don't We Design Better Apparatus so as Not to Need Protective Relays?

It might seem offhand that the money spent on protective relaying should rather be spent on better apparatus. However, the fact is that no matter how much care is taken in the manufacture and use of a piece of apparatus, there is still a possibility of failure. Even if a manufacturer could build entirely trouble-free apparatus, the purchaser probably could not afford to pay for it. It is more practicable to accept some failures as inevitable, and to employ protective relays to minimize their subsequent effects on the rest of the system.

To What Extent, Then, Does Apparatus Design Enter the Picture?

Electrical failures are failures of insulation to insulate. Hence, the design of apparatus to prevent electrical failure centers on the choice of the kind of insulation to use, and on the control of those factors which stress insulation. Toward this end, standards have been set up that are agreeable both to manufacturer and purchaser. There are various classifications, or grades, of insulating material, and there are various design features of apparatus using these insulations. Of course, designers are constantly alert to the possibilities of new materials and new techniques that will improve their product without making it cost-

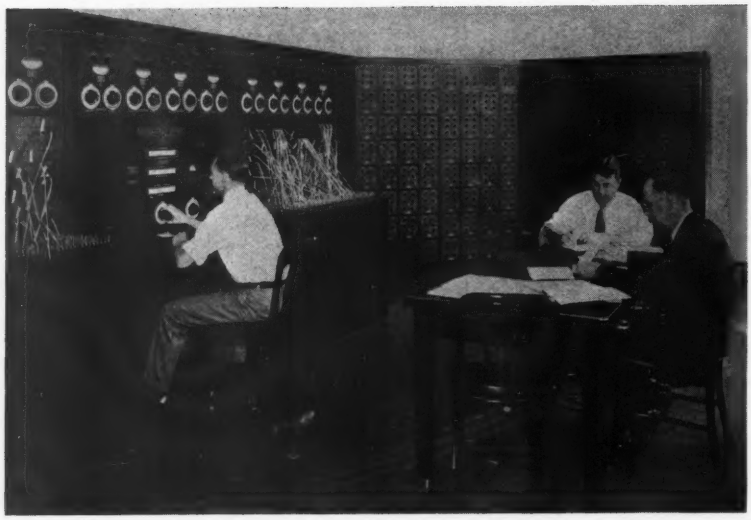


Fig. 2. Determining what happens when a short-circuit occurs

lier. At any rate, when a purchaser chooses a particular piece of apparatus, he knows to a certain degree its probable life and freedom from trouble. Then, if he takes good care of the apparatus, and operates it within its rating, the apparatus will live out its life expectancy unless something unforeseen happens to cause a short-circuit.

What Causes Short-Circuits?

The causes of short-circuits or "grounds" are many and varied. They can probably be classified under one of the following: age, hidden defects, unanticipated severe operating conditions, abuse, mistakes of man, and a group of unpredictable things that "just happen." All of these are more or less beyond the control of a designer. (Fig. 1)

How do Protective Relays Minimize the Consequences of Short-Circuits?

The moment a short-circuit occurs, certain protective relays operate to cause tripping of the circuit breaker, or breakers, which will disconnect the defective apparatus from the rest of the system. In this way, the damage to the defective apparatus is minimized, and the rest of the system is relieved of the defect.

Doesn't this Disconnection of Apparatus Shut Down the Plant?

It is to be expected that some short-circuits will cause more inconvenience than others. Nevertheless, the plant cannot continue to operate with a defective unit "hanging on," and so it must be removed from service for repair or replacement; the sooner it is removed, the less damage there will be to repair. And most power plants are designed and operated in such a way that the temporary loss of a piece of apparatus will not shut the plant down.

To What Extent Does Plant Design Enter the Picture?

Insofar as it is practicable, plant design and operation follow the old adage, "Don't put all of your eggs into one basket." Spare, or reserve apparatus and alternate circuits for carrying various loads are provided. The degree of duplication of apparatus and circuits depends on the importance to plant operation of any particular one of them.

Circuit breakers are placed in the various circuits in order to be able to disconnect any piece of apparatus that might become defective.

In other words, the protection of power plant equipment lies not only in the proper choice and application of protective relays, but in the design of the plant itself so that it can be well protected.

Why Can't an Attendant Trip the Necessary Breaker When a Short-Circuit Occurs?

Of course, if an abnormal condition develops slowly, such as a gradual temperature rise in a machine, an attendant can and does take the necessary steps to correct the situation. There are many such things that do not require protective relays in attended stations, but that do require protective relays in unattended stations. However, speed and accuracy in tripping the proper breakers are absolutely essential when a short-circuit occurs. And no person could act as quickly or as accurately as a protective relay even if he were at the right place at the right time.

If No One Could Perform as a Protective Relay, How Can Anyone Design a Protective Relay to Do the Job?

Man can build many things to do what he himself cannot do. An electric circuit does in an instant things that might take man days to calculate. But, nevertheless, he can calculate, or find out by test, what will happen under any given circumstance.

The designer is interested in two different types of circumstance—one, when short-circuits occur within a particular piece of apparatus, and for which a particular relay should trip a breaker, and the other, when short-circuits occur elsewhere, and for which that relay should not trip. By calculation, or test, or both, he tries to find some difference between the two types of circumstance as regards what the electric circuit will do. Then, he devises a protective relay that can distinguish between these differences, and that will operate to trip in the one case but not in the other. When he finishes, the designer has a sort of superhuman device because he has endowed it with the ability to discriminate instantly between two different classes of circumstance that took him days or weeks to separate. Nor could the designer, even knowing what difference to look for, ever act as quickly and as accurately as his relay. It is a case of the student excelling the teacher. (Fig. 2)

But Does the Designer do this for Every Piece of Electric Apparatus in a Power Plant?

In a way, yes. Actually, he designs one kind of a protective relay for providing certain protection to generators, and this relay can be used for almost any generator. Then, he produces another device for transformers, and so on. In other words, he makes several different kinds of tools, each for use in a particular kind of job. And like any tool, the protective relay must be used, or applied, correctly to do what its designer intended.

Then, There are Different Types of Protective Relays Used for Different Purposes in Power Plants?

That is correct. Each piece of apparatus is connected to the cir-

Table showing Relays used in Different Classes of Service

	Over-Current	Under-Current (Field)	Under-Voltage	Over-Voltage	Reverse-Power	Temp.	Over-speed	Direct. Over-Current	Phase-Balance	Diff.
Generator:										
Hydro-Electric	Z	Z		Z		Z	X			X
Steam-Electric	Z	Z			X	Z				X
Power Transformer		Z				Z				X
Main Bus										X
Station Service Transformer	X									A
Station Service Bus	X									A
Station Service Feeder	X							Z		
Essential Auxiliary Motor	X									A
Non-essential Auxiliary Motor	X		Z			Z			Z	A
Main Exciter					A*					
Pilot Exciter (Hydro-Electric)				X						

X—Generally-used type.
A—Alternate to generally-used type.
Z—One or more sometimes used in addition to generally-used type.
*No protection is provided except when exciters are paralleled.

cuit through a circuit breaker, and each breaker is arranged to be tripped by some kind of protective relay best suited to that particular job. Consequently, there is no portion of the circuit that is unprotected. (Fig. 3)

What Are These Different Kinds of Protective Relays?

The different kinds of protective relays used for the protection of power plant apparatus are as follows:

Over-Current
Under-Current
Over-Voltage
Under-Voltage
Reverse-Power
Temperature
Over-Speed
Directional Over-Current
Phase-Balance
Differential

The names of the first seven types tell the quantity that actuates each particular relay. For example, the current relay is actuated by current obtained from current transformers or shunts located in the circuit of the device to be protected. Thus actuated, the relay may be designed to operate when the current exceeds a predetermined amount, and we should call it an "over-current" relay. Or, it may be intended to operate if the current falls below a given value, in which case it would be called an "under-current" relay.

The last three types are current-, or voltage-actuated, but their names do not reveal the mechanism by which they operate. The directional over-current type functions only for a given direction of excess current flow. The phase-balance type functions when there is an unbalance of current or voltage between the phases of a 3-phase circuit. And the differential type functions by virtue of a difference between the current flowing into and out of a piece of apparatus.

Any of these relays may be chosen to operate instantly or with time delay, depending on the requirements. Time delay is generally resorted to when it is impossible to determine immediately whether or not a short-circuit requiring tripping actually exists. Often, a time delay relay is used because it is less costly and provides sufficient protection, even though a faster, and hence more costly, relay would provide better protection. The cost is not necessarily in the relay itself, but may be mostly in the auxiliary equipment such as current and potential transformers, etc., required to actuate the relay.

Do You Always Use the Same Type of Relay for Protecting the Same Kind of Apparatus?

The practice is quite well standardized. Occasionally, however, there are considerations that cause a departure from standard practice. While there is usually a recognized best way of protecting any piece of apparatus, there are, nevertheless, alternative ways. The best way may not be chosen because it is costlier than some other way, either because the relay itself is costlier or because the circuit does not have the necessary breakers, current transformers, etc., and they would have to be added in order to use the best relay to full advantage. And, it may be considered that the apparatus is not important enough to warrant the best form of protection. Then, there is personal preference.

What are the Standardized Forms of Protection for Power Plant Equipment?

The accompanying table shows the various types of protective relays generally used for protecting electric equipment in attended

(Continued on Page 84)

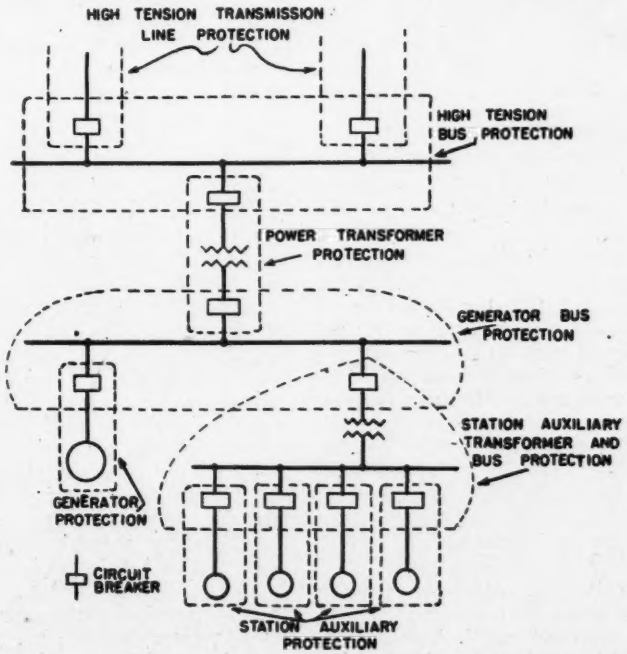


Fig. 3. Zones of protection of different types of relays

IF YOU CAN'T DO BUSINESS—

It's Your Own Fault

BY RICHARD H. MORRIS
Engineering Editor

Change to a new line with curtailment of old standbys may seem formidable, but if you want to keep the wolf from the door next year with your organization intact—and incidentally further the Defense Program—you'll take on a bit of Uncle Sam's business and let him worry about Priorities. Of recent weeks all Government contracting has been co-ordinated in a single agency with many district offices; subcontracting in the future will be mandatory with price differentials allowed for plants with older equipment, or, in emergency unemployment areas. Contracts and political pull are unimportant—you'll deal with experienced industrial engineers who know their job as well as yours and can help pull production costs in line with previous bids. This year's effort of 1 out of every 8 hr. for defense will have to be doubled, tripled and quadrupled to compete with Hitler's 5 out of every 8 hr. for military purposes

WHATEVER else it may have accomplished, the last year and a half have definitely shattered the myth that American productive capacity is adequate to carry on an unlimited emergency defense program without disturbing the normal economic life of the nation.

The National Defense Program has not bogged down for, measured by original schedules, progress has been satisfactory if not phenomenal. Industrial production has been pushed to about 145 per cent of the 1929 peak, and, while only 12 to 14 per cent has been diverted for military purposes, this proportion should be doubled by next June. To these totals must of course be added a tremendous amount of construction, directly or indirectly related to defense and an essential preliminary to actual production.

The program did, however, fail in two important objectives. First, it did not tap the reservoir of potential capacity in the easily used small and medium sized plants, the essential element of speedy production with the flexibility necessary to meet indeterminate but constantly expanding needs. Second, it failed to provide a practical solution for the migration, absorption or protection of employes and management in industries not readily convertible to defense needs.

While both of these were recognized as essential, the obvious solution was, and still is barred from consideration by a steadfast insistence in solving the problem in the American way by voluntary co-operation of labor, management and government. All three of these failed to some extent: the government in not pointing out the way; labor and management by not displaying sufficient initiative and co-operation to do the job unaided.

As a result, by late summer, the country was confronted with the paradoxical situation of billions of dollars of business going begging on one hand, whole communities facing bankruptcy and tens of thousands of skilled workers facing unemployment on the other. Of the billions in government contracts awarded, some 75 per cent were fed in at the top through 56 large companies with only a small proportion of the work sifting through to the smaller companies, and, to put the matter inelegantly, America's industrial machine was constipated.

Corrective measures prescribed[1] by the President in September are becoming increasingly effective and were compounded from drastic revisions in Army and Navy purchasing policies. Awards formerly made solely on the basis of price and delivery are now made with due regard to a third factor: spreading the work. Provision for these changes, made by Executive order and by legislation introduced in Congress late in October, will for the duration of the emergency, allow greater latitude in: placing cost plus fixed fee awards; restricting competitive bidding to zones; eliminating performance bonds; allowing freight differentials; and permitting contracts with pools or associations.

Coincident with changing the purchasing policy, the Defense Contract Service, a minor bureau in the Division of Production of the O.P.M. was raised in status, renamed the Division of Contract Distribution and given authority as a co-ordinating and administrative agency. The primary purpose of the new division is to spread out defense contracts so as to speed production.

In this it will co-operate with other governmental departments and O.P.M. divisions in: promoting subcontracting, on both new and existing contracts and in the conversion of civilian industries to defense production. Recognizing the limitations set by centralizing all activities in Washington, this work will in the future be carried on by district field offices, staffed by engineers with an intimate knowledge of the problems of defence, produc-

[1]The Executive order establishing the Div. of Contract Distribution of O.P.M. was published in Sept. 9 issue of the Federal Register, Vol. 6, No. 175. The Director of Priorities' order for curtailment in the use of copper appeared in the Oct. 22 issue, Vol. No. 6, No. 206. The "Federal Register" is a government daily carrying the official announcements, notices, orders and regulations of various governmental departments. Subscriptions should be sent to the Supt. of Documents, Government Printing Office, Washington, D. C. Subscriptions: single copies 10 ct.; monthly $1.25; yearly $12.50. Notices from the O.E.M. agencies are reprinted in the weekly supplement of "Defense," see Footnote 4.

tion and needs of the local districts.

Changes in Army and Navy purchasing policies used to spread the work and promote subcontracting are based largely on the removal of restrictions on making awards as mentioned earlier. Specifically some of the ways in which this is, or will be, applied in practice are:

1. Breaking large quantities into smaller units to permit smaller concerns to bid for appropriate quantities, or dividing awards to several of the lowest instead of to a single low bidder.

2. Reducing the time allowed for completion of the contract so as automatically to eliminate manufacturers who have the tools but are already loaded up with defense contracts. This is considered an effective method of shunting prime contracts from the eastern districts, now 100 per cent on defense, farther west, but must be used advisedly to prevent the use of critical materials earlier than actually needed.

3. Requiring the contractor to subcontract a minimum percentage of the total and when evaluating bids, giving more favorable consideration to bidders agreeing to subcontract larger portions.

4. In special cases where adequate idle subcontracting capacities is available, withholding delivery of, or priority orders for, machine tools needed for new or existing contracts. An exception is made when only a few limited tools are necessary to complete a production in assembly line. Few plants have all the machine tools needed for a large contract and subcontracting is thus made almost mandatory. Cost estimates made on the basis of using certain machines unavailable to subcontractors are subject to revision.

5. Giving favorable consideration and price differentials to group resources bidding on prime contracts under the so-called "York" or "Mother Hen" plans. There are many variations of this, but the general plan is for a number of plants with limited facilities to pool their equipment, each agree to do a portion of the work and enter a combined bid in the name of one prime contractor. The possible price differential allowed takes into consideration the type of machines available to do the job.

6. Restricting bidding to definite areas or zones.

7. Special consideration and price differentials for manufacturing centers designated or certified as "priorities unemployment areas." Under the new setup it is possible, although not always easy, to act quickly, and, considering an area or industry as a unit, take steps to alleviate an emergency by special awards or allotments.

Perhaps the most important function of the field offices, however, is acting as a clearing house for bringing prime contractors and subcontractors together. On the surface this seems like a simple job of tabulation and filing—on one side the machine tool facilities for rent, on the other the machine tool facilities needed. Actually it is a tremendous job and can be done effectively only by trained engineers. An idea of the difficulty is indicated by the fact that a single eastern contractor, not the largest by any means, employs a force of 300 men scouring the country for subcontractors.

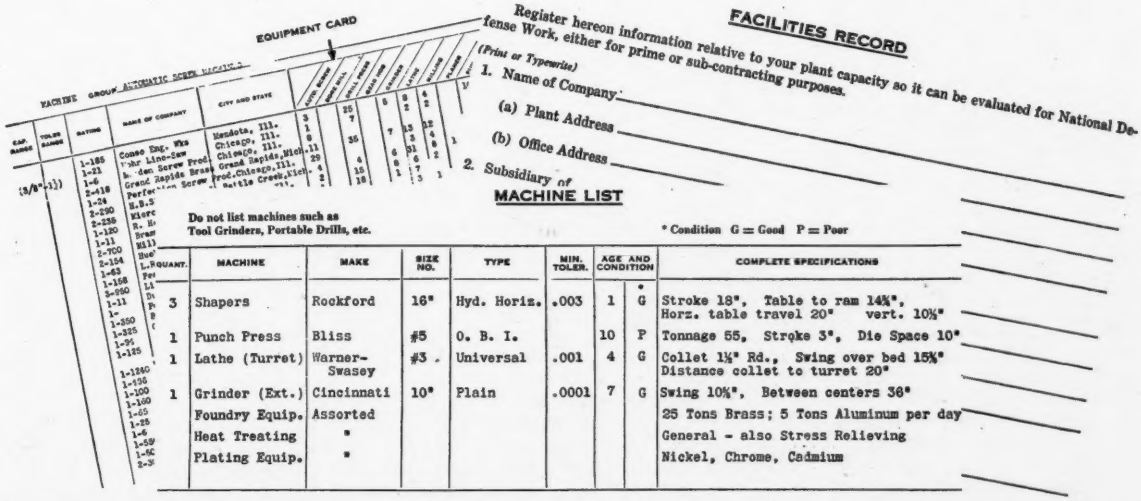
Details of handling the problem vary from district to district with the local needs and organization experience. Recently a certain degree of standardization was introduced by adoption, for national use, of certain forms and methods developed in the Chicago office[2] and shown by Fig. 1 and Table I.

While this is perhaps the most important role played by the field offices it is only one of the many services rendered. They are intended as clearing houses of information for all government purchasing and in addition:

1. Issue frequently and mail to banks, newspapers, Defense Councils, manufacturers associations and chambers of commerce, lists of subcontracts and prime contracts open for bids, with sufficient information to enable a manufacturer to know whether the work is suitable for his plant. The lists run from Soup to Nuts, the first item on a recent Navy list being Worcestershire Sauce. However, the greatest demand is for plants with metal working tools or those that can make army clothing, process foods, sew heavy canvas or make instruments.

2. Maintain a file of many blueprints and specifications[3] which will be duplicated quickly for eligible bidders. If these specifications are not on file

[2]The forms shown by Fig. 1 as well as the classification of metal trades groups in Table I were developed by S. M. Roberts, Senior Engineer, Div. of Contract Distribution, Chicago Section, as an experienced engineer's approach to a complicated and difficult problem. Their intrinsic worth is indicated by many months successful use in the Chicago Office and by the fact that: the Facilities Record was recently adopted without change by Washington as a National standard for D.C.D. offices; and the group classification was adopted in its entirety by the Navy for breaking down its stock catalogue in a much more usable form than the traditional alphabetical arrangement. Mr. Roberts was formerly plant engineer of the American Flange & Mfg. Co. of Chicago. Thomas S. McEwan is manager and W. Homer Hartz co-ordinator of the Chicago District.


EQUIPMENT CARD

FACILITIES RECORD

Register hereon information relative to your plant capacity so it can be evaluated for National Defense Work, either for prime or sub-contracting purposes.

(Print or Typewrite)

1. Name of Company

(a) Plant Address

(b) Office Address

2. Subsidiary of

MACHINE LIST

Do not list machines such as Tool Grinders, Portable Drills, etc.

* Condition G = Good P = Poor

QUANT.	MACHINE	MAKE	SIZE NO.	TYPE	MIN. TOLER.	AGE AND CONDITION	*	COMPLETE SPECIFICATIONS
3	Shapers	Rockford	16"	Hyd. Horiz.	.003	1	G	Stroke 18", Table to ram 14¾", Horz. table travel 20" vert. 10½"
1	Punch Press	Bliss	#5	O. B. I.		10	P	Tonnage 55, Stroke 3", Die Space 10"
1	Lathe (Turret)	Warner-Swasey	#3	Universal	.001	4	G	Collet 1¼" Rd., Swing over bed 15¾" Distance collet to turret 20"
1	Grinder (Ext.)	Cincinnati	10"	Plain	.0001	7	G	Swing 10¾", Between centers 36"
	Foundry Equip.	Assorted						25 Tons Brass; 5 Tons Aluminum per day
	Heat Treating	"						General - also Stress Relieving
	Plating Equip.	"						Nickel, Chrome, Cadmium

Fig. 1. From these Plant Facilities records and files the Division of Contract Distribution of O.P.M. is able to act quickly in putting potential subcontractors who are looking for work in touch with prime contractors looking for idle machine tool capacity. These particular forms were developed by the Chicago office. The Facilities record, partially shown on the right and center, was known locally as Form 31-5B and there were approximately 5000 on file in the Chicago District when it was adopted as the national standard for all D.C.D. offices. In spite of wide publicity many of the smaller and medium sized plants are not yet registered. Any plant looking for work should contact the nearest Div. of Contract Distribution Office and register their equipment and plant facilities. Addresses of the main offices are listed in Table II. The form on the left is used for locating a specific type or size of machine. A more elaborate file, broken down as shown by Table I, is used for locating groups of machines to do many operations with consideration of quality of work

the office will help to get them quickly. In many cases models of the parts to be made are available. Exhibits of this kind are being built up as rapidly as possible.

3. Compile and distribute lists of prime contractors and lists of manufacturers in various industries such as shipyards, aeroplanes and parts, machine guns and rifles.

4. Distribute general information booklets such as "Army Purchase Information Bulletin," "Selling to the Navy," "Subcontracting for Defense," etc.

5. Assist prospective bidders in qualifying for the Navy "invitation to bid" list.

6. Maintain reference files of current government[1, 4] and commercial publications[5] of specific information or value.

7. Give technical assistance in converting facilities for defense purposes and in preparing bids.

8. Help to arrange necessary financial assistance through local banks or government agencies for handling defense production.

9. Have available a so-called "Shopping List" which gives previous prices paid for various items.

10. Co-operate in arranging exhibitions of defense material, conducting defense production clinics, etc.

To insure that no qualified bidder misses, for lack of information, an opportunity to get a defense contract, the Division of Contract Distribution recently embarked on a widespread publicity program. In November three display trains of eight cars each embarked on a tour of the nation and expect to interview some 30,000 small manufacturers. The trains will include exhibits of needed military parts and equipment, blueprints and specifications. Again a large number of Defense Production Clinics will be held over the country in the next few months to bring prime and subcontractors together. In spite of the widespread publicity, many of the smaller plants are not yet registered either with the Div. of Contract Distribution of O.P.M. or with the Ordnance Department.

What to Do

Assuming that a manufacturer has had no previous experience in government work, either as a prime or subcontractor, but wishes to investigate either as a matter of necessity, patriotism or good business, he should, regardless of size, proceed as follows:

1. DO NOT GO OR SEND A REPRESENTATIVE TO WASHINGTON where they are already snowed under with administration problems and are not familiar with local conditions. Instead contact the nearest Division of Contract Distribution office of the O.P.M. There is already at least one in every Federal Reserve Bank, one in nearly every state and new branch offices are being added each day. The address of the main office in each district is given in Table II. The Federal Reserve district in which any particular city is situated can be found from any bank, and, from the main district office the location of the nearest branch office can be obtained.

2. Contact the nearest branch office, preferably by personal call; find out what they have; become familiar with their procedure; obtain and read the booklets on Army and Navy purchasing requisites; and ask for and file a plant survey or Facilities Record form. At the same time obtain the address of the nearest Army Ordnance District office so as to file with them a record of your plant facilities.

4. After becoming familiar with the procedure, it is necessary to keep careful watch of the invitations to bid. Formerly these often appeared with inadequate time to prepare a bid. Through the efforts of the Field offices, the armed forces now allow at least 15 days except on emergency items. Invitation to bid may be followed through the Div. of Contract Distribution lists or through private[5] publications. These publications also carry notices of contracts awarded and can supply tabulations of bids.

5. After this it is a job of selling, no different from private business. The government is not a single agency but a

Table I. This classification of the metal trades group, not heretofore published, was also developed by and has been in use for many months in the Chicago office. It is based primarily on the art of manufacturing so that companies having certain groups of specialized equipment and skills can be readily located. Within recent weeks, the Navy adopted this classification for breaking down standard stock catalog[3], in which some 160,000 items were formerly arranged alphabetically. With the new breakdown a specific manufacturer can readily locate the Navy purchase items which he might logically supply. The Navy adopted the Chicago classification in its entirety with no change except subdivision of three groups as indicated above by A and B

No.	Classification	Example
1A	Assembly only	
1	Auto screw machine products	Studs, bolts, bushings
2	Castings—ferrous	Iron, steel foundries
3	Castings—non-ferrous	Aluminum, brass foundries
4	Die castings	Radiator grills, ornaments
5	Electric equipment	Motors, control equipment
*5A	Electric communication systems	Radio, telegraph, signal system
6	Forgings—ferrous	Iron, steel
7	Forgings—non-ferrous	Aluminum and brass
8	Gears—all types	Spur, worm, herringbone
9	Heat treating	Hardening, annealing, stress relieving
10	Instruments (precision)	Gages, micrometers, watches
11	Machines—heavy	Derrick, steam engine
12	Machines—light	Lawnmowers, washing machines, vacuum cleaners
13	Machines—precision	Typewriter, adding machines
14	Machines—transportation (land)	Automobiles, trucks, motorcycles
14A	Machines—transportation (air)	Aircraft and aircraft materials
14B	Machines—transportation (water)	Boats, boat and ship supplies
15	Machine tools—large	Lathes, punch presses, milling machines
16	Machine tools—small	Drills, taps, cutters, hand
17	Metal products—misc. (job basis)	General machine shop products
18	Metal products—misc. (prod. basis)	Bearings, valves, fittings, toys
19	Metal tubing products	Chairs, beds
20	Metal spinning products	Spun aluminum utensils, brass dishes
21	Plastic moulding	Trays, ornaments
22	Plating—all types	Chromium, nickel, brass
23	Sheet metal—stamping, drawing	Discs, washers, cups
24	Sheet metal—fabrication	Barrels, tanks, stoves, boxes, cabinets
25	Structural iron and steel	Bridges, fire escapes, buildings
26	Tool and die—precision	Jigs, fixtures, dies
27	Welding—all types	Steel, brass
28	Wire products, other than electrical	Strainers, pail handles, paper clips
29	Miscellaneous (Not covered by above)	

[3]Certain parts of the Navy Stock Catalog can be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C. Both this and the Federal Specifications are covered by Price List 75 which will be supplied upon request. Navy Specifications are issued only to contractors and prospective contractors. The Navy Stock list, Federal and Navy Specifications are on file at most D.C.D. offices. If not, the office personnel will assist in procuring them.

[4]Various defense agencies (including the O.P.M.) come under the President's Office for Emergency Management or O.E.M. News of all defense agencies is carried in the official weekly "Defense" which may be ordered from the Supt. of Documents, Government Printing Office, Washington, D. C. Subscription 75 ct. yearly or 25 ct. quarterly. The Government Printing Office issues weekly a list of new publications which will be sent free of charge upon request. To facilitate ordering low cost publications, the Superintendent of Documents sells, in units of 20, coupons valued at 5 ct. each in exchange for public documents.

[5]Two of these are the "Federal Purchasing Record" (weekly) and "Daily Record" published by the Atlas Publishing Co., 123 W. 21st St., New York. Another is the "U. S. Government Advertiser" published weekly with offices at 511 Eleventh St., N. W., Washington, D. C.

[6]This is a complete guide, lists all government departments with the top personnel, activities, authority and in many cases a brief history of the department. It is revised three times yearly and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. Single paper bound copies are 75 ct., yearly subscription $2.00. General information regarding all phases of governmental activity can be obtained from the United States Information Service, 1405 G St., N. W., Washington, D. C.

Table II. Addresses of the Office of Production Management, Div. of Contract Distribution offices in the 12 Federal Reserve Districts. Additional branch offices are being established and will eventually number 150 to 200. If you are looking for Defense work, do not apply to Washington, but find out from your bank or the main D.C.D. office in your Federal Reserve Bank District the location of the nearest branch office and contact them for assistance. In the following list the main office in each district is indicated by an asterisk (*)

No.	City, State and Address
1*	Boston, Mass., Fed. Res. Bk. Bldg.
2*	New York, N. Y., 33 Liberty St.
2	Buffalo, N. Y., Fed. Res. Bk. Bldg.
3*	Philadelphia, Pa., 925 Chestnut St.
4*	Cleveland, O., Fed. Res. Bk. Bldg.
4	Cincinnati, O., Union Trust Bldg.
4	Pittsburgh, Pa., 717 Grant St.
4	Youngstown, O., Union Nat. Bk. Bldg.
5*	Richmond, Va., 9th & Franklin Sts.
5	Baltimore, Md., Fed. Res. Bk. Bldg.
5	Charlotte, N. C., Fed. Res. Bk. Bldg.
6*	Atlanta, Ga., 104 Marietta St.
6	Birmingham, Ala., Fed. Res. Bk. Bldg.
6	Jacksonville, Fla., Fed. Res. Bk. Bldg.
6	New Orleans, La., Carondelet & Common St.
6	Nashville, Tenn., Fed. Res. Bk. Bldg.
7*	Chicago, Ill., 164 W. Jackson Blvd.
7	Detroit, Mich., Fed. Res. Bk. Bldg.
8*	St. Louis, Mo., 411 Locust St.
8	Little Rock, Ark., P. O. Box 1261
8	Louisville, Ky., Todd Bldg.
8	Memphis, Tenn., Fed. Res. Bk. Bldg.
9*	Minneapolis, Minn., Rand Tower
9	Helena, Mont., Fed. Res. Bk. Bldg.
10*	Kansas City, Mo., Fed. Res. Bk. Bldg.
10	Denver, Colo., Fed. Res. Bk. Bldg.
10	Oklahoma City, Okla., Fed. Res. Bk. Bldg.
10	Omaha, Neb., 1701 Dodge St.
11*	Dallas, Tex., Fed. Res. Bk. Bldg.
11	El Paso, Tex., Fed. Res. Bk. Bldg.
11	Houston, Tex., Fed. Res. Bk. Bldg.
11	San Antonio, Tex., Fed. Res. Bk. Bldg.
12*	San Francisco, Cal., Fed. Res. Bk. Bldg.
12	Los Angeles, Cal., Fed. Res. Bk. Bldg.
12	Portland, Ore., Fed. Res. Bk. Bldg.
12	Salt Lake City, Utah, Fed. Res. Bk. Bldg.
12	Seattle, Wash., Fed. Res. Bk. Bldg.

veritable Medusa, each head of which must be sold separately. Keep in constant contact with as many as possible, not so much for prime contracts as for possible subcontracts. As in everything new, the first break is the most difficult, but once started most manufacturers find that they can build on this start with increasing ease.

Army and Navy Buying

Army purchasing is not centralized (beyond the co-ordination offered through the Contract Distribution Div.) but is carried on independently by the Air Corps; Chemical Warfare Service; Engineer Corps; Medical Corps; Ordnance Department; Quartermaster Corps; Signal Corps; by each arsenal and by small local purchasing in hundreds of posts and camps throughout the country. District offices are maintained by each major department, but the procurement districts vary and are not the same for each branch.

Navy purchases are centralized to a degree in the Bureau of Supplies and Accounts, but the Bureau of Yards & Docks; Bureau of Ordnance; and Judge Advocate General purchase certain materials. The Marine Corps and Maritime Commission each makes its own purchases independently. Most of the Lend-Lease awards are made by the Army. The Army and Navy pamphlets mentioned earlier explain the organization quite thoroughly and further information of a more general nature can be obtained from the United States Government Manual[6].

Business Contacts

Above all keep in touch with local associations and other manufacturers and, if possible, approach the Contract Distribution Div. as a group with pooled resources.

Fig. 2. Doing business at a Defense Production Clinic, many of which will be held over the country in the next few months. Prime contractors list the machines and facilities they are looking for, (see upper left hand corner of photo), bring along blueprints and samples of things they want made. Manufacturers looking for work file past until they find something they can handle. Leaving the Chicago Clinic held in October, a contractor of 28 t. tanks said: "The last place in the world we would have looked—in a flour mill—is where we found the machinery we needed"

There are some 184,000 manufacturing plants in the country; about 134,000 of these employ 20 or less and in the aggregate use about 5 per cent of the raw materials and employ 10 per cent of the workers. As a rule these plants cannot be reached individually, although there is a possibility of using them effectively as part of a larger unit. To a certain extent this also applies to many of the remaining 50,000 larger plants and their chances of success are also greatly enhanced by working through local defense councils and chambers of commerce.

Usually, small shops are not skilled in working to close tolerances. If the machines are adequate, training of personnel may remedy conditions, or as is being done in some cases, they may be used for the roughing cut, with the finish cut made somewhere else. In isolated cases, shops with one or two skilled machinists have been used very effectively.

With greater latitude allowed in dealing with manufacturing pools or associations, the effectiveness of the small plants is expected to be greatly increased, especially in regard to prime contracts. Prime contracts sounds formidable—big league stuff running into millions of dollars on a single contract. While there are many of these, there are also many small ones for a prime contract is nothing more than an award or order direct from the government as contrasted to subcontracting. Not all prime contracts are for complete equipment. In many cases the government agency agrees to supply parts to the prime contractor and these parts are then awarded to a second prime contractor.

Impending Unemployment

With the actual and prospective restrictions on the civilian use of metals, widespread unemployment of plants, industries and communities is impending and may well become critical before the situation is taken care of in the regular way.

In cases of this kind, get in touch immediately with the nearest State Employment Service office and file Form ES 223.

This is a new form, as yet not widely known, and intended to give ample warning of impending unemployment so that the community can be certified so allocations of materials and locations of new plants can be influenced quickly. In this again action by an industry or community group is much more effective than that of the individual. The necessity for cooperative efforts by trade associations, Chambers of Commerce, local defense councils, etc., cannot be overemphasized.

Opportunity for the Individual

Finally, if you are an individual whose job depends on the continued existence of your company, see that these points are brought to the attention of some executive. While the American Business Man prides himself on his self reliance and independence, indications are that many are actually coasting on the reputation of past generations. Thousands, either unable to resist the temptation of easy business, or, allowing an undue reliance on "business as usual" to warp their perspective, are not now prepared to assert this independence and they find it increasingly difficult to meet the new conditions which wiser competitors anticipated. Defense business is going out at the rate of two billion dollars a month and while it is not being handed out on a silver platter, the Div. of Contract Distribution will furnish a spade and even show, those who are looking for work, where to dig.

And everyone will have to dig, for the Defense job has been started and has to be put over. An idea of what lies ahead is indicated by the following composite quotation from a recent confidential meeting with the men who are actually doing the work of putting it across: "The situation isn't going to be any easier, it is going to be tougher . . . neither manufacturers nor workers are really conscious of the job ahead . . . so far we have been hoping that the job wouldn't have to be done, that the good Lord would take Hitler by the neck and move him out of the picture, but . . . the Lord helps those who help themselves . . . (and) now the most desirable thing to help the production process is to realize that there is trouble ahead for us . . . we have got to work to win or be prepared to lose."

Protective Relaying For Attended Power Plants

(Continued from Page 79)

power plants. Unattended power plants will require more protective relays for providing protection against situations which an attendant could handle if he were present.

Do These Relays Ever Fail to Work Properly?

Rarely, a relay will trip a breaker when it should not, or fail to trip when it should. Unnecessary tripping is usually no fault of the relay, but of its application or adjustment; of the two types of improper operation, this is the more likely. Failure to trip may be the fault of the relay, its auxiliary equipment, or the circuits involved; the principal defense against this is good maintenance. If the circumstances surrounding a faulty operation are accurately reported, the causes usually can be determined and corrected. Consequently, large responsibility rests with a station operator or attendant to report all relay operations as accurately as possible.

On the rare occasion when a particular relay fails to trip a breaker when it should, the fault is generally cleared by the operation of other protective relays according to what is called "back-up" protection, or because the fault spreads to other apparatus whose relays then operate. As a last recourse, breakers may have to be tripped manually.

It Certainly Seems that Protective Relays are Essential to the Safe and Effective Operation of Power Plants

That is true. The problem of power plant protection is like the traffic problem in a busy city, if we may use another analogy, and the protective relays and circuit breakers together are like alert, well-trained policemen constantly watching the flow of traffic. Normally, the traffic flows orderly through designated routes, but in the event of an accident, the policemen quickly divert the traffic to other existing routes until normal conditions can be restored. This diversion may be accompanied by some inconvenience to the traffic, depending on the importance of the route which has been closed and on the volume of traffic at the time. But there is the least tie up, and the obstruction can be removed with the least delay, thus permitting the quickest reopening of the route.

We may display a certain aloofness toward our policemen, and we may deplore the conditions that make our policemen necessary, but we still are comforted in knowing that they are always on the job in case we should need them.

And so it is with relays, the guardians of the power system.

Illinois Professional Engineering Act

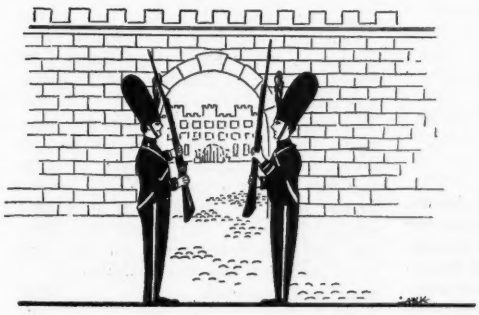
THE ILLINOIS Professional Engineering Act, filed July 24, 1941, becomes effective as a law August 1, 1943. On and after that date it will be unlawful to practice Professional Engineering without being licensed by the Department of Registration and Education except for certain exemptions. The only persons required to register are those in responsible charge of Engineering work for consulting engineers or in responsible charge of Engineering work for the State or local governments.

While relatively few engineers will be required to register under the provisions of this Act, many will no doubt desire to register to avoid any difficulty should they desire or find it necessary to do so at some later date. The Department of Registration and Education is not in a position to furnish application blanks, copies of the complete law, or to answer inquiries at this time, as it has no appropriation for this purpose. They will not be able to answer inquiries until the Department receives its next appropriation in the 1943 General Assembly.

The Illinois Engineering Council has had copies of the complete Act printed. They are on file with the Secretaries of the member organizations of the Illinois Engineering Council which includes: American Association of Engineers (Illinois Assembly), American Society of Civil Engineers (Illinois Section), American Society of Civil Engineers (Central Illinois Section), Association of County Highway Superintendents, Illinois Association of Highway Engineers, Illinois Society of Engineers, Western Society of Engineers, American Institute of Chemical Engineers (Chicago Section), American Institute of Electrical Engineers (Chicago Section), American Society of Mechanical Engineers (Chicago Section) and Illinois Professional Communication Engineers Association.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR



'TEN SHUN!

With this last issue of 1941 I relinquish this very pleasant job of running the Practical Engineer and Electrician to my staff associate Richard Morris. He needs no introduction to you but in some ways he deserves your sympathy. This time "I slipped a fast one" on him. Just before turning the job over to him I induced the management to increase the Practical Engineer Section from its customary 16 pages to the 24 pages it occupies in the present issue. This is going to be fine for all of you fellows who so delight in calling each other names in "Letters and Comments," since it provides you with a wider field of action but poor old Dick Morris still doesn't know what he is in for. Twenty-four pages, even if by the grace of God and the untiring efforts of our advertising sales staff we can sell several of them to advertisers, is a lot of space to fill and so, feeling the Christmas spirit coming on, I am asking you to help him. This is the least I can do. Send him things to put in these pages. Send him your pet theories, your ideas about plants and equipment, operation and management. Send him your trick gadgets, your super-watzits (see p. 93), your secret ambitions, yes even your tales of woe—your worst headaches. He will appreciate them. If you can't write glamorous English don't let that stop you; just give Dick the facts and he will throw in the glamour. You will be surprised to see what he can do with wretchedly few facts. A modest genius, he deserves your support.

Well, as the police radio operators say, "That is all." Having basked in the reflected radiance of Pulverizer Pete's wit, Mr. Aint's shining phrases and all the other brilliance that has illuminated these pages during the year, I now take my leave. I am going back into the comparative oblivion from whence I came. It has been "swell" to work with you and in leaving these pages I want to extend to all of you my thanks for your fine support and my best wishes for a Merry Christmas and a Happy New Year.

A. W. Kramer.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

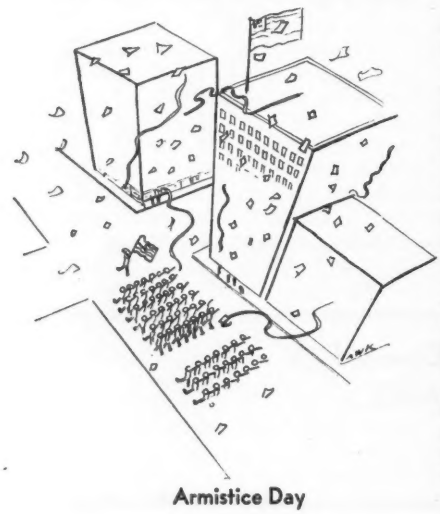
THE LONG VIEW

BY ANDREW KRAMER

If you are looking for a technical article or for an article that can help you keep your plant running or show you how to build a new one don't read this. As a matter of fact there is probably no logical reason that we can advance why you should read it at all. It is about the war and maybe, as most of us are, you are fed up on the war. Strangely enough, however, perhaps that is one reason why you might want to read it. It discusses the war in a calm, detached sort of way which may make it seem less cockeyed even if, in our hearts, we know it is just that

THESE LINES are being written on November 11—Armistice Day. As I look out of the window a few minutes after eleven o'clock in the morning a few handfuls of odd and sundry pieces of waste paper are fluttering in the air, remnants of a feeble and half-hearted attempt of a few office workers to celebrate the occasion in the traditional way. On the streets below several companies of Legionnaires are parading to the beat of drums, but they attract little notice and somehow look rather pathetic. Enthusiasm seems lacking; Armistice Day, for the time being at least, has lost its former significance. The celebration of an armistice and all-out preparation for war are not quite compatible.

These matters have little relation to the technical matters usually considered in these columns, yet they are not entirely out of place here at this time. In this last issue of the year it can do no harm to set aside the practical considerations of engineering and give some thought to where we stand in the world of today. In a letter from one of our readers, presented in this issue, he suggests that we, as engineers, give serious consideration to what we may be able to do after the war is over, since he feels that the work of reconstruction is largely a task for engineers to undertake. I do not necessarily agree with him in this respect since engineers have never shown themselves any more capable than other groups in handling human problems, but certainly it can do no harm to discuss such matters.



Armistice Day

What Do They Mean—"All-Out"?

During the past year we—all of us in this country—have been engaged in a so-called all-out effort for National Defense. Of course, any sensible person must be quite aware of the fact that, so far at least, it has been nothing of the kind. There is a considerable difference between a real all-out effort and what we have been doing. Despite the ballyhoo our all-out effort is somewhat like the fluttering bits of paper in the air today.

With some exceptions, the defense effort has affected most of us but little. In general our lives follow the accustomed American pattern. We work and play, wear good clothes, eat more than is good for us, three to six times a day, consume vast quantities of candy, guzzle good liquor and bad, go to the movies, neck, pet, kill and disable some 25,000 people a year with our automobiles, listen to the radio, read far too many newspapers and continue to complain about the weather and high taxes. There is much talk about the necessity for sacrifice with the last syllable pronounced "fiss", but little evidence of any. In numerous instances, true, the nature of our work has changed, but even here much of it concerns only the purpose. An operator in a machine shop who 2 yr. ago was turning out valve stems for automobile engines today may be fashioning breech mechanisms for anti-aircraft guns, but fundamentally his work remains the same. He may work longer hours, but the chances are he gets overtime for it. We are paying more taxes, but also we are making more money. If we are in business we find it difficult to get certain things and there is endless discussion of allocations and priorities, but, by and large, the American scene is still much the same. Those whose lives have been fundamentally altered are the million or more young men who have been drafted or who have enlisted in the Army or Navy.

We Think Differently

The greatest change which recent events in the world has made in our lives is in our thinking. Here there has been a fundamental change. In a world which we once felt possessed a semblance of order and which seemed to offer a degree of stability and security, we now find everything topsy-turvy. We can no longer make plans for anything very far ahead and we find it difficult, in a figurative sense, to keep our feet on the ground. We no longer know what to think. On a planet which, it seems, has ample resources we find the inhabitants on the one hand encouraging the building up of men and materials and on the other hand destroying them with all the consummate skill and ruthlessness modern technology commands. On the one hand, we move heaven and earth to keep alive some suffering and hopelessly deformed baby, or some worn out octogenarian and on the other hand send to certain destruction the flower of our young manhood. It doesn't make sense.

Mars His Idiot

In mentioning these things I do not want to be misunderstood. I am not an isolationist. There was a time when I was as much against war as any rational human being and today I agree with all H. M. Tomlinson said about war in his devastating blast against it,[1] but circumstances have led me to believe that with the world as it is, with the people in it as they are, this conflict was inevitable. For us, our first objective must be to win it.

Its sources lie far deeper than the personal ambitions of Hitler and Mussolini. It has its origin in centuries of misuse and exploitation of human and material resources; more directly it results from the unequal development in our social and political systems as compared with that of science and technology. These facts cannot alter our course of action, but it will help our mental attitude if we keep them in mind.

In an older world devoid of split-second world communication and trans-oceanic air transportation this misuse and exploitation could continue over long periods without causing world wide dislocations and disturbances, but with the world as it is, that is no longer possible. Despite the contentions of the isolationists, oceans and vast land areas

[1]Mars His Idiot.

are no longer barriers between peoples of varying temperament, culture and material resources.

Blame the Steam Engine

The developments in transportation and communication are, of course, only manifestations of our knowledge in the development and application of mechanical power. The question of power —the production of goods by mechanical power, lies at the base of nearly all our troubles. The condition has been building up ever since the so-called mechanical revolution. The development of the steam engine doing the work of hundreds and later thousands of men and doing that work 24 hr. a day, 7 days a week, brought man face to face with a situation the like of which had never before appeared on earth. Its implications for improving the lot of mankind were enormous, but it also held in it the means of greater exploitation and misuse of resources.

The growth of wealth in the first quarter of the 19th Century as a consequence of the advent of the steam engine was startling, but also, to any who looked beneath the surface, was the misery and poverty among the workers. With it, also, came the beginnings of unemployment.

These things are matters of history and it is not the purpose of this article to review them in detail. It will be well for all of us, however, to keep them in mind in thinking and forming opinions about the war. None of us can get away from the war—we are all in it, but if, by a logical consideration of the events which led to its beginning, we can think of it dispassionately, we will be better fitted to withstand its hardships. And if we can look beyond Hitler and Mussolini for the cause of the trouble, the better will be our chances of ultimately helping to bring about a readjustment. The war in itself is of course a means of readjustment.

There are some, and they are among our most sincere and well meaning people, who think that the necessary readjustment can be attained without war, but to me, that seems quite impossible. Theoretically, it could be done, but practically all conditions are against it. Centuries of conditioning of people's minds and habits, years and years of misrule, exploitation and jockeying for economic control, have made all the peoples of the world suspicious of one another. Few of them are willing to give up any of the advantages they feel they possess and deliberately instilled erroneous patriotic, religious and cultural ideals have spread intolerance among them. The lag of political and social unification behind technological development has resulted in endless obstruction. For many centuries large masses of the world's population have been held in submission by political forces which they had no means to resist. Today the economic interest of the greater portion of mankind demands that this state of affairs be changed. This political unification of human society is inevitable, but the question is whether it is to be imposed by armed force or achieved by a meeting of minds. That is what this war is about.

The Shape of Things to Come

Yet, it cannot be supposed that this particular conflict, when it is over, will solve our troubles even if Germany is defeated.

World War I certainly did not solve our troubles. There is no question that the present violent state of world affairs will pass, but it is unlikely that it will violently or radically change the course of human history. There will be change, however. It is quite obvious that two systems such as our Democratic system and the National Socialist system of Hitler cannot exist side by side, but the chances are that regardless of which side is victorious neither system will prevail in its entirety. The longer this war is stretched out, the more both sides suffer by attrition the more likely is this to be true.

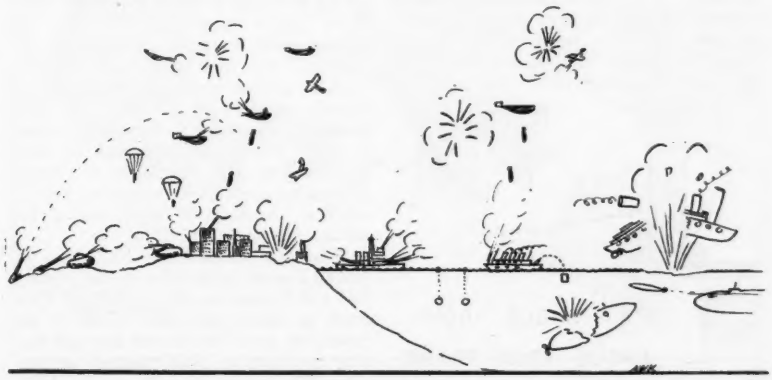
In his "Shape of Things to Come," H. G. Wells portrays a world so devastated and torn by repeated conflict that it lies helpless and depopulated for many decades before the beginnings of a new world order manifest itself. It is improbable that this particular prophecy of Wells' will come true, but the idea involved is a valid one and the kind of a world that will emerge from the present turmoil depends to a considerable extent on how much both sides are depleted. For this reason, strange as it may seem, and however illogical, it probably will be best if this war does not end too soon.

The prospects, while not particularly pleasant, are not entirely discouraging, if one can accept the long view. The war is one manifestation of an evolutionary process that has been going on for a long time, but that has only become really critical since man discovered how to develop and apply mechanical power. This is the evolutionary process tending to bind all the diverse peoples on this planet inseparably into one great economic union.

Population and the Steam Engine

The influence of the invention of the steam engine has been considered in previous issues of this publication, but some figures in an article by Harry Scherman in the November *Atlantic Monthly* are of particular interest in this respect. Since 1750, about the beginning of the power age, according to Mr. Scherman, the human population of the earth has more than tripled. It was then about 660,000,000; it is now well over 2,100,000,000. This increase has not been an evolutionary phenomenon with biological causes. Prior to it, the scholars find that for many centuries there was no such definite population trend. The population of any living group tends to become stationary as a function of the food supply and there is evidence that this state had been reached before 1750. Periods of excessive birth must have alternated with periods having an excess of deaths. Yet, there was an evolution—an evolution in the world's economic organization. The true import of this great fact, as Mr. Scherman puts it, is plain; 1,500,000,000 more human beings can now remain alive on the earth's surface because of the power of steam and water to do man's physical work. More food can be raised and it can be more effectively distributed. To enable these people to live, however, it is necessary that they learn to co-operate and allocate raw materials and distribute goods so that the economic and political structure as a whole can function as a unit. That is the problem which confronts us, one which, so far, we have been unable to solve.

As individuals there is comparatively little we can do. We can do our work to the best of our ability and in the interest of the nation, meanwhile preserving a healthy mental attitude. If the world seems a trying place to live in these days it may help to read a little history because in the reading of history we find that these times are not quite as bad or as hopeless as the emotional outpourings of some radio commentators or the screaming newspaper headlines might lead one to believe. It is well enough to keep abreast of what is going on, but too serious or concentrated attention to the endless succession of nerve shattering news broadcasts is not going to help anybody's peace of mind. The war will pursue its inevitable and inexorable course.



The War

FOR THE PLANT ELECTRICIAN

How To Make A Transformer Welder

By Leslie Bradley

As I HAVE RECEIVED several inquiries in regard to how to wind the transformer for the welder that was shown in the March, 1941 issue of POWER PLANT ENGINEERING and as it would be quite a job to answer each inquiry individually, I have prepared the following article with the thought in mind of helping others who might wish to make their own welder. Therefore, I will endeavor to make this article as explicit as possible so that anyone with a limited knowledge of transformer winding can make a welder that will work.

The welder that was shown in the March issue was made mostly from material we had on hand. All that was purchased was the electrode holder, shield, cable and couple range receptacles to connect welder to the supply circuit. The core for the transformer was taken from an old 10 kv-a. transformer that had burned out the original windings. The wire that was used was taken from the coils of an old direct current generator.

The first thing to consider in winding a transformer to be used for an arc welder is the core. As the number of turns of wire for the primary coil depend on the cross section of a side of the core, the size should be large enough so that the number of turns be near or less than one turn per volt. And the sides of the core should be long enough so that the coils can be kept as small as possible. This will require a core having about 4 sq. in. in the cross section of one side. Ours had 4.5 sq. in.

The laminations of the old transformer we used were 1½ in. wide and 8 by 12 by 1/64 in. cut in an L shape. The core for the welder was arranged to form a frame 8 by 12 in. on outside and 5 by 9 in. on inside, using enough laminations to build up the core to a thickness of about 3 in. These laminations were clamped together both at top and bottom by using 1 by 1 in. angle iron, shown in Fig. 1. Of course, the laminations cannot be clamped together before the coils are wound, for they will have to be assembled by inserting each lamination through the centers of each coil as shown in Fig. 5. When the core is built up as much as possible then the clamps can be bolted on. On the clamps to be used at the bottom of coils, holes should be drilled to allow bolting the transformer to the framework of welder. (Fig. 5)

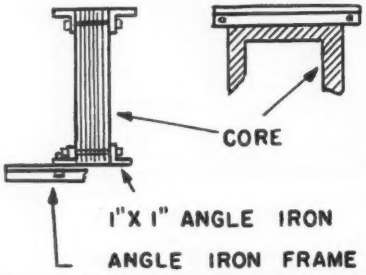


Fig. 1. Detail of core construction and mounting

If an old transformer cannot be obtained then the core can be made up by cutting thin sheet iron to right dimensions. Each lamination should have a thin coat of insulating varnish applied before assembling, so as to insulate each lamination from the others. After the core dimensions have been determined, then the size of wire that is to be used to wind the coils should be considered.

Most welders are wound to get their supply current from a 220-v. circuit and deliver about 60 v. on the highest taps of the secondary winding. The welder will draw about 60 amp. at 220 v., and the size of wire has to be large enough to carry this current safely. No. 6 wire for the primary coil will not be any too large. For the secondary coil a much heavier wire has to be used, about a No. 0 wire for instance.

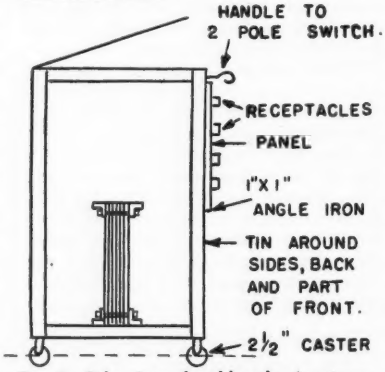


Fig. 2. Side view of welder showing transformer and control panel

As it would be hard to wind a wire much larger than No. 10 with the average shop equipment, it would be advisable to buy wire that is much smaller than is needed and then wind several strands of wire in parallel. The only caution to observe is to use enough wires to more than equal the size of wire needed. The wire should be a suitable magnet wire, with a thin covering for insulation. Amount of wire needed for welder will be around 40 lb.

The wire we used was No. 12, so we wound 3 wires in parallel on the primary coil and 7 wires on the secondary. Care must be taken that these wires do not cross over each other in winding and that they are kept as close together as possible. The length of coils can be determined by measuring the length of the sides of the core, shown at A-B in Fig. 5.

To wind the coils, plane a piece of wood to the exact dimensions of the sides of core and then saw this piece at an angle, as indicated in Fig. 3 at "B". This is done to allow getting the wood out of coils after they are wound. The end pieces "A" are for the purpose of forming the coil ends and should be lightly tacked to the wood strips to hold them in place. The distance between these pieces is governed by the length of coil to be wound. In winding, this assembly, Fig. 3,

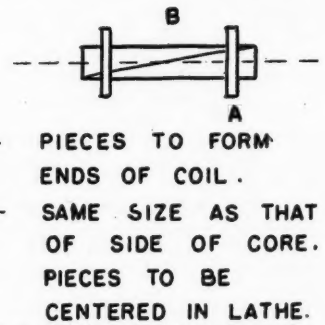


Fig. 3. Split form used in winding coils

should be centered in a lathe so it can be turned to wind on the wire. One of these assemblies should be used for each coil.

The primary coil will have as many turns of wire wound on it as the voltage per turn is divided into 220 v. As the voltage per turn should equal 1 v. or less, at least 220 turns will be required.

Before winding any wires on the wood form, wrap two or three thicknesses of fish paper, or its equivalent, around the wood for insulation. Insulating varnish can be used to keep this paper in place till the wires are wound over it.

To start winding leave enough wire to extend out from ends of coil so as to solder a lead to it after the coil is formed. Start winding, being sure to keep all wires close together, with equal tension and that no wires cross each other. When the wires have reached the other end of the form, apply a coat of insulating varnish, then wrap a thickness of heavy wrapping paper, cut to right width to just go between end pieces of form, around the coil, using varnish to stick paper together. Continue winding wire over this paper till it reaches the end of coil from where the winding started, varnish the wires, wrap with paper, as be-

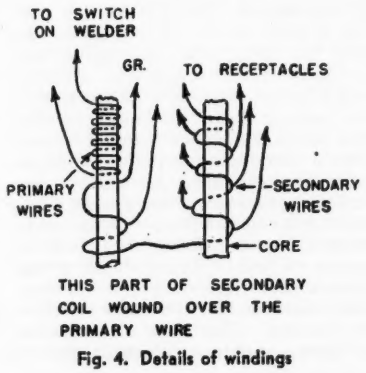


Fig. 4. Details of windings

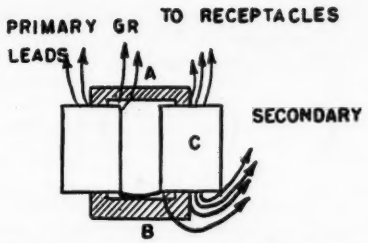


Fig. 5. Side view showing leads from transformer

fore, and continue this till the right number of turns have been wound on coil, then bring the ends of wire out far enough for second lead, wrap several thicknesses of paper on coil and secure with string or varnish.

In winding the secondary coil, the procedure is the same as for the primary coil. We wound 7 wires in parallel on the secondary coil. Thirty turns were wound on the secondary coil, which was assembled on the opposite side of core from the primary coil, "C" Fig. 5. Then about 25 turns were wound over the primary coil, see Fig. 4. When winding part of the secondary over the primary coil, wind in same direction in which the primary wires were wound.

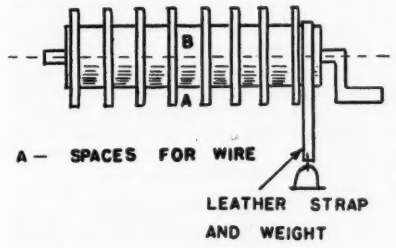


Fig. 6. Cylinder used in winding coils

The secondary coil must be connected as shown in Fig. 4, otherwise the coils will not function as they should. If there should be any question on connecting the secondary coils together they can be tried out, by temporarily connecting the two coils and then do some welding. It is a good idea to try out the transformer by connecting up temporarily and trying out the various taps. If some do not give enough heat to weld, then they need not be connected up to the panel.

Tap leads should be soldered securely to all wires and be long enough to extend far enough out from ends of coils so as to solder on wires with a much heavier insulation, these wires to attach to suitable plugs or receptacles, "A" Fig. 7, so that the electrode cable can be easily changed from one heat to another. A good flat ribbon braid made of fine stranded wire is best to use for the conductors that are soldered to the coil wires and extend to the outside of coil. These conductors should be insulated by themselves as they pass over the other wires in the coil.

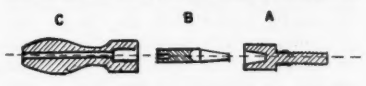

C
B
A
A— RECEPTACLE TO BE BOLTED ON PANEL AND CABLES CONNECTED BY USE OF TWO NUTS.
B— PLUG, SOLDERED TO CABLE ON ONE END
C— HANDLE TO BE INSERTED OVER PLUG (B)

Fig. 7. Details of plug and receptacle

In tapping the secondary, the coil that surrounds one side of the core should be tapped every five turns, the part that is wound over the primary only twice and the inside lead of this part should extend to the ground connection, Fig. 4.

To wind so many wires in parallel a suitable reel was devised as shown in Fig. 6, to wind the different wires on so as to feed all wires that are wound in parallel on a coil at one time, and also to keep all wires at the same tension.

To make the reel, turn down a piece of wood to about 6 in. in diameter and long enough to hold all the wire that is needed to wind the coil at one time. Each wire should be wound on this cylinder by itself, and these wires can be kept from each other by driving pins, or otherwise, so as to keep these wires from tangling with the other wires on the cylinder. After the wires were wound on this cylinder it was set up in a frame, a few feet from the lathe and all seven wires were then fed to the coils at one time. On this cylinder a brake or loading strap of leather was placed to keep a slight tension on the wires, as they were unreeled from cylinder. The primary coil wires can be handled just the same. The cylinder arrangement is shown in Fig. 6.

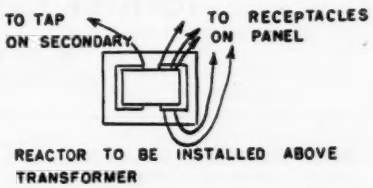
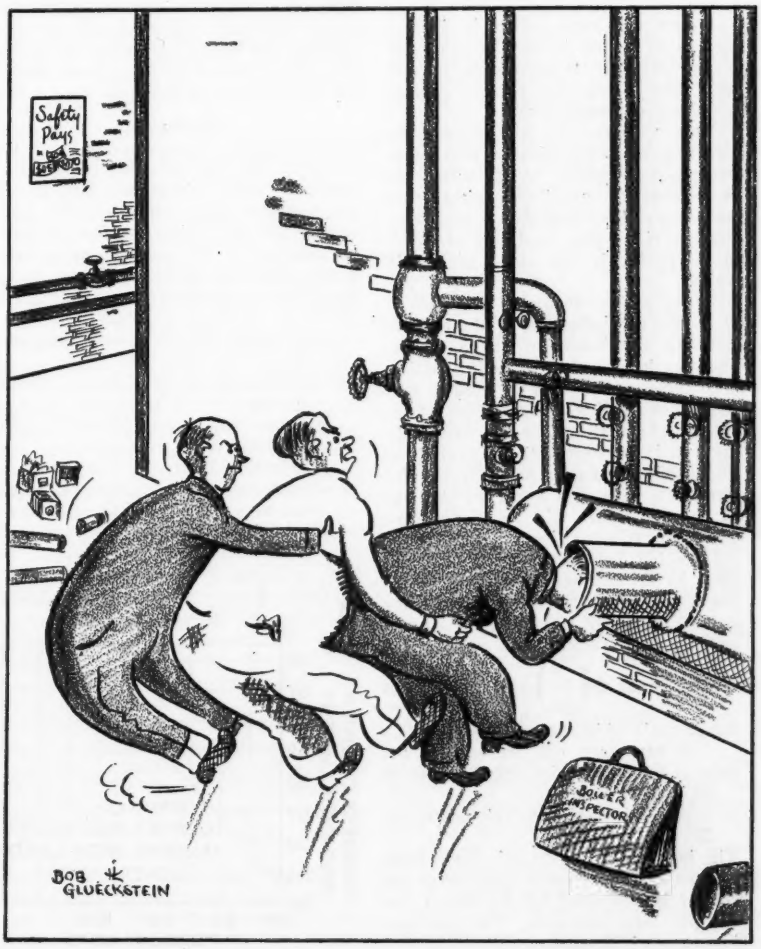


Fig. 8. Reactor

In all the winding process extreme care must be taken not to damage the insulation of the wire and to see that none cross over each other. Also see that the tension is the same for all wires.

To make the plug-in receptacles, "A" Fig. 7, which should be placed on a suitable panel, can be turned out of a piece of brass 1 in. dia. by 3 in. long, cut 1½

(Continued on Page 91)



"Maybe this will teach you not to be so darn nosey!"

Operation of a 25 Cycle Transformer on 60 Cycles

By W. C. SEALEY
Allis-Chalmers Mfg. Co.

Editor's Note: Most of the alternating current distribution systems operate at 60 cycles, but there are still some dating back to former times which operate at 25 cycles. Gradually, these older systems are being converted to 60 cycle systems. When such a change has to be made the utilization of existing 25 cycle equipment usually comes up for discussion, particularly in the case of the transformers. The 25 cycle transformers can be used on 60 cycles, but their characteristics naturally will be different. The following discussion of this subject by Mr. Sealey was presented first in the Allis-Chalmers Electrical Review, but it is fundamental engineering information that every electrical engineer should possess and so we reproduce it here. Mr. Sealy not only gives the factors by which the 25 cycle values must be multiplied to get the 60 cycle conditions but shows how they are applied in a particular case.

WHEN a 25 cycle system is changed over to 60 cycles, it may be desirable to use the old transformers for 60 cycle service, generally without change in voltage or connections.

This changeover will affect the operating characteristics of the transformers, particularly such factors as kv-a. rating, no-load loss, exciting current, copper loss, impedance, and temperature rise. The insulation strength on 60 cycles is the same as on 25 cycles.

When a transformer is operated at 60 cycles, the induction in the core is 25/60 of the induction at 25 cycles. The core loss at the reduced induction at 60 cycles varies with the kind of iron in the core and its original induction, but in general it will be approximately equal to 55 per cent of the 25 cycle loss. The exciting current for different designs will vary still more widely, but an average figure will be 15 per cent of the 25 cycle exciting current.

The I^2R loss in the copper for the same kv-a. will be the same in both cases. The eddy current loss will vary as the square of the current. Consequently, the 60 cycle eddy current loss will be equal to $\left(\frac{60}{25}\right)^2$, or 5.76 times the 25 cycle eddy current loss.

The reactance will increase in the ratio of the frequencies, or will be equal to $\frac{60}{25}$ or 2.4 times the 25 cycle reactance.

The impedance can be calculated from the per cent resistance (100 times the copper loss divided by the kv-a.) and the per cent reactance. The per cent impedance is equal to

$$\sqrt{(\%\ \text{Resistance})^2 + (\%\ \text{Reactance})^2}$$

If the transformer is self-cooled, the oil temperature rise will vary as the 0.8 power of the total loss. The temperature difference between the copper and the oil varies in a complex manner which is different for each design of transformer. However, for copper loss slightly in excess of full load, where R is the ratio of the copper loss at load L_2 to the loss at load L_1, an approximate equation is

Temperature difference between copper and oil for load $L_2 = R$ (temperature difference with load L_1) $+ 10(R - 1)$.

A further limitation of the allowable load at 60 cycles is sometimes present when the lead currents are large. The heating of the outlet leads due to eddy currents may limit the maximum load current which can be carried. (The 60 cycle eddy current loss in the leads is 5.76 times the 25 cycle eddy current loss.) Similarly, the heating of the transformer cover due to the 60 cycle magnetic flux may be a limitation when the outlet currents are large.

Example

A transformer to be changed over to 60 cycles has the following rating and characteristics at 25 cycles: 2000 kv-a., single-phase, high voltage 13,200, low voltage 2300, 55 C rise, core loss 10-kw., exciting current 5%, copper loss at 75 C 20-kw., I^2R loss at 75 C 19-kw., total loss 30-kw., impedance 4 per cent, oil rise 40 C, copper rise 55 C,

Core loss $= .55 \times 10 = 5.5$-kw. approx.

Exciting current $= .15 \times 5 = 0.75\%$ approx.

Eddy current loss $= (20 - 19)\ 5.76 = 5.76$-kw.

I^2R loss $= 19$-kw.

Copper loss $= 19 + 5.76 = 24.76$-kw.

Total loss $= 5.5 + 24.76 = 30.26$-kw.

Reactance at 25 cycles $=$

$$\sqrt{(4)^2 - \left(\frac{20 \times 100}{2000}\right)^2} = \sqrt{15} = 3.87\%$$

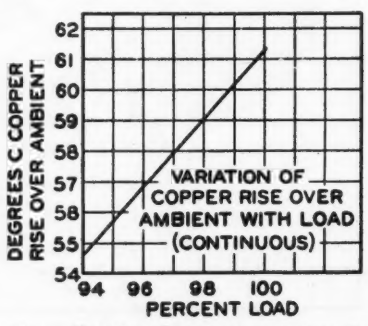


Fig. 1. Variation of copper temperature rise over the ambient with continuous load

Reactance at 60 cycles $= 2.4 \times 3.87 = 9.3\%$

Impedeance at 60 cycles $=$

$$\sqrt{(9.3)^2 + \left(\frac{24.76 \times 100}{2000}\right)^2} = 9.38\%$$

$$\text{Oil rise} = \left(\frac{30.28}{30}\right)^{.8} \times 40 = 40.3\ \text{C}$$

$$R = \frac{24.76}{20} = 1.238$$

The copper rise over oil at 60 cycles equals $1.238 \times 15 + 10\ (1.238 - 1) = 21$C. The total copper rise over the ambient temperature $= 40.3 + 21 = 61.3$ C.

By calculating the rise for several loads and plotting points on a curve, the load which will result in 55 C rise can be determined. For example, the following points are calculated as given above.

Per Cent Load	Copper Rise
100	61.3
98	59.0
96	56.8
94	54.6

From the curve, it can be seen that the 55 C rating of the transformer is $.944 \times 2000 = 1888$ kv-a., or 1900 kv-a. in round numbers. The exciting current on this base $= \frac{2000}{1900} \times .75 = 0.79\%$ approx.

The copper loss $= \left(\frac{1900}{2000}\right)^2 \times 24.76 =$ 22.2-kw. The per cent impedance $= \frac{1900}{2000} \times 9.38 = 8.9\%$.

Summary of Constants

To find the characteristics of a 25 cycle transformer when operating at 60 cycles, multiply the 25 cycle values by the following factors.

Quantity	Factor
Insulation Strength	1.0
Core Loss	0.55 approx.
Exciting Current	0.15 approx.
I^2R	1.0
Eddy Current Loss	5.76
Per Cent Reactance	2.4

The temperature rise and kv-a. rating for 55 C rise can be determined by methods described in the text.

A-C Wiring in Conduit

By Eugene George Key

When large capacity electrical circuits are used, such as feeds for buildings or large shops, experience has shown that several cables in parallel for every phase in a 3-phase system is usually better than one large cable per phase. Whenever an installation of this kind is used, the electrician should be careful to see that a complete set of cables is carried by every conduit used, rather than every phase being placed in a conduit by itself.

Suppose, for example, that a 3-phase system is being installed and it is necessary to use two or more cables for each phase. The tendency for many wiremen is to put all cables for phase A in one conduit, all for phase B in a second, and all for phase C in a third.

If a neutral line is used, the cables for it would be carried in a fourth conduit. In one installation of this kind, the conduits became so hot that it glowed a faint cherry red when the cables were heavily loaded. Changing the connections so that every conduit carried a complete set of cables solved the problem.

The reason for this condition is that around every conductor carrying current is a magnetic field. When the phases are separated, the magnetism surrounds all the cables in the conduit which then becomes the secondary of a one-to-one transformer. Because of the comparatively low resistance of the conduit, large currents circulate. If these currents are large enough, the conduit will become exceedingly hot, although the heating may not be so evident if the currents are relatively small. These currents, however, represent a considerable power loss which may run ino many dollars a month even though the conduit temperature might be negligible to the touch.

When every conduit contains a complete set of cables, the magnetic field around each one is neutralized and no transformer action takes place.

One other benefit is gained by placing a complete set of cables in a conduit. A fault on any phase will take only one set of cables out of service, leaving the parallelled cables in the other conduits serviceable. If separate conduits are used for each phase, a fault on one cable will take the entire phase out of service.

The same conditions are true if the run is 2-phase or even single-phase if the two sides of the line are separated. Direct current presents no such problem unless it is the output of a static rectifier without a wave filter to smooth out the pulsations. Even in direct current, however, the conduits should contain both sides of the line and the neutral (if any) to protect against loss of service caused by a fault in one cable.

Steam Engine Lubrication

By E. M. SIMS
Instructor, Mech. Eng.
University of Oklahoma

THE MINIMUM quantity of oil that will properly lubricate the cylinder of a steam engine during a period of time depends primarily upon the area swept over by the piston during that period of time. The area passed over by the piston in a given period of time is directly proportional to the bore, stroke, and speed of the engine. Therefore, the quantity of oil required per unit of time may be represented by the equation:

$$Q = C D L N$$

Where: D is the diameter of bore in inches
L is the length of stroke in inches
N is R. p. m. of engine
C is a constant which will be determined

Experiments have shown that, under favorable conditions, a pint of oil will lubricate 1.5×10^6 sq. ft. of surface swept over by the piston in a period of 10 hr. of operation. The square feet of surface area passed over by the piston during a 10-hr. period, in terms of bore, stroke, and r.p.m., is:

$$3.14 \times \frac{D}{12} \times \frac{L}{12} \times N \times 2 \times 60 \times 10 = 26.17\ DLN$$

Therefore the number of pints of oil required per 10 hr. operation, in terms of bore, stroke, and r.p.m., is given by the equation:

$$Q = \frac{26.17\ DLN}{1.5 \times 10^6} = 17.45 \times 10^{-6}$$

for 100 hr.:

$$Q = 17.45 \times 10^{-5}\ DLN$$

As illustrated by the chart on page 108 this equation may be shown graphically for a wide range of engine sizes and speeds, thus providing a rapid method of estimating oil requirements. It should be pointed out, however, that the equation should not be used indiscriminately since there are other factors which affect oil requirements to a certain extent, such as the mechanical condition of the engine, load carried, degree of atomization of the oil, etc.

Probably the only method of determining positively that the minimum amount of oil for proper lubrication is being supplied, is to examine the interior of the engine after extensive tests have been run.

Maintenance of Hand Fire Extinguishers

FIRE EXTINGUISHERS, to be instantly available for use at all times, must be properly recharged and inspected. The date of recharging should be noted on the tag provided for that purpose, along with the name or initials of the man doing the work.

Fire insurance underwriters recommend that only recharging materials and replacement parts furnished by the manufacturers of the extinguishers be used in service work. Full instructions for recharging the various types of extinguishers are given on the labels and they should be followed to the letter.

When the 2½-gal. units are recharged, all parts should be washed thoroughly in water and the water drained through the hose. The shell should be examined to make certain it is sound at the seams, for, after all, it is a pressure container. The head gasket and hose should be examined for signs of deterioration, and the strainer should be cleaned.

When the cap is screwed back on the shell, the worker should make certain that at least four threads are engaged. A small amount of vaseline may be placed in the threads to make the task easier and facilitate removal for the next recharging.

All chemical solutions should be mixed in clean containers and not in the shell of the extinguisher, and the container should be carefully rinsed before being used for a new solution.

Only liquid obtained from the manufacturer should be used in the vaporizing liquid type extinguisher. The use of commercial carbon tetrachloride, which may contain some water or chemical impurities, is likely to damage the interior of the extinguisher or, if used on live electrical equipment, endanger the operator.

Directions for Inspecting and Recharging Extinguishers

SODA-ACID:
Recharge annually. If exposed to temperatures below 40 deg. F., place in suitably heated cabinets. Do not mix anti-freeze crystals with the solution.

FOAM:
Recharge annually. Anti-freeze ingredients should not be added to the solution and if exposed to temperatures below 40 deg., extinguishers of this type should be kept in suitably heated cabinets.

VAPORIZING LIQUID:
Recharge after use and keep unit filled at all times. Test action of pump by discharging a portion of the liquid into a clean, dry container. The test liquid can be poured back through the filler opening. Guard against overfilling. No lubricants should be used on the piston of this type of extinguisher, nor should any water be placed in it.

LOADED STREAM:
Recharge after use; inspect annually to see if container is filled and that hose and gasket are in good condition. Weigh carbon dioxide cylinder and replace it if it has lost one-half ounce. Extinguishers of this type may be exposed to temperatures as low as 40 deg. below zero F.

CARBON DIOXIDE:
Recharge after use; inspect annually to note if seal is intact. Weigh the unit to make certain weight is equal to that stamped on it. Loss of 10 per cent in weight indicates the need for recharging.

ANTI-FREEZE, PUMP TANK:
Recharge after use; inspect annually to make certain it is filled to filling mark. Test pump action by operating pump for several strokes, directing the stream back into the tank.

ANTI-FREEZE, OTHER TYPES:
Recharge after use; inspect annually to see if container is filled and that hose, gasket, etc., are in good condition. If carbon dioxide is used for pressure, loss of one-half ounce in the weight of the cylinder is cause for replacing it with a new one.

How to Make a Transformer Welder

(Continued from Page 89)

in. down to about ½ in. and thread. This part to go through panel and to bolt on the connections coming out of secondary coil. On the other end, bore out for 1¼ in. and cut this hole so as to get a taper of around 3 deg. Then obtain another piece of brass to make the part "B" Fig. 7, which will fit in taper hole on part "A" and have the electrode cable soldered on to it. A wooden handle should be turned to allow the cable to pass through center

so as to make it easier to change the cable from one heat to another. "C" Fig. 7.

Our welder did not have a reactor, but better results will be had if one is provided. If one is provided it should be connected to a lead from the secondary coil that has a rating of around 100 amp. The reactor will have leads, tapped from it as shown in Fig. 8. At least a No. 6 wire should be used for this coil and the taps can be tapped every 5 turns.

In selecting the electrode for this type of welder one should experiment with several types of rod until one or two types are found to give best results. The size rod used should in most cases not be over $\frac{1}{16}$ in., and it will be found that a $\frac{1}{8}$ or $\frac{3}{32}$ in. rod will give best results.

The frame was made as shown in Fig. 2, from right angle iron, tin and a piece of insulating material for a receptacle panel.

FOR THE STEAM ENGINE OPERATOR

I Was Baffled By A Baffle

By George Holman

IN MY WORK around mines, machine shops, refrigeration systems and power plants I have often been faced with peculiar and puzzling problems. Some of these problems, more than I like to admit, have had me up a stump, at least for a time. One of the most baffling, if not the most baffling, of all the problems I have so far encountered concerned a Chuse 4-valve non-releasing cross compound engine driving a 650 kv-a. generator direct.

In 1934 I operated this engine. I thought that I knew this engine well enough to put my finger on whatever could possibly go wrong with it. The management thought so, too. We were both wrong.

While laboring under the hallucination that I knew this engine, the management called me into consultation on the evening of July 3 last. At 1:30 that afternoon the engine, equipped with an automatic shut-off throttle valve, had shut itself down. But what was so puzzling about the incident was that the engine came to a dead stop within 10 sec. It looked for the world like the automatic shut-off valve had closed. And so I advised the management of my opinion. That opinion is not worth much right now.

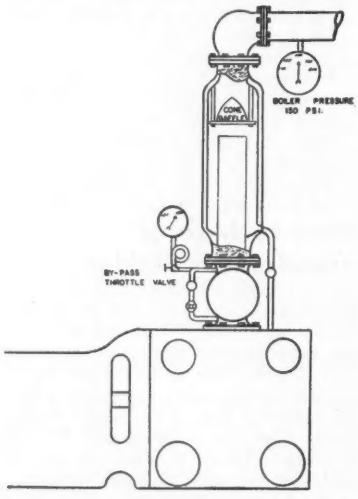


Fig. 1. Section showing the separator as it was originally installed

The next day I went to the plant to see what had been done about the engine. The maintenance man had dismantled the automatic shut-off throttle valve, and fastened the seat to the stem. This made it into a common throttle valve. But still the engine would not carry the load. At slightly more than

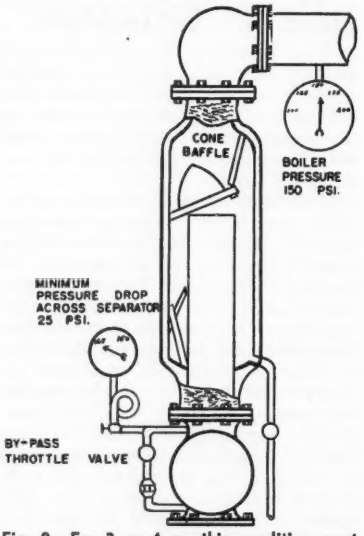


Fig. 2. For 3 or 4 yr. this condition must have prevailed

20-kw., with power factor at 87 to 88, the frequency began to drop, and at 250-kw. the governor released. At the instant of governor release the frequency meter showed 57 cycles. This was usual for the engine, I was told. It had not carried more than 250-kw. for 3 or 4 yr. When it first began to fail a consulting engineer had been called in. He had claimed that the trouble lay in the step-up transformers, where the voltage was raised to a 2300 transmission line. Upon his advice the generator had been rewound to generate at 2300 v. Still the engine would not carry the load.

As is customary around power plants whenever a puzzling situation arises, each man had his own—and a different—opinion of what was wrong with the engine. The maintenance man thought that the exhaust line was stopped up. A night engineer thought it was the receiver. Another man thought a gate in the valve on the main from the boiler was down. My idea of what was wrong was as bad as theirs. Having convinced myself

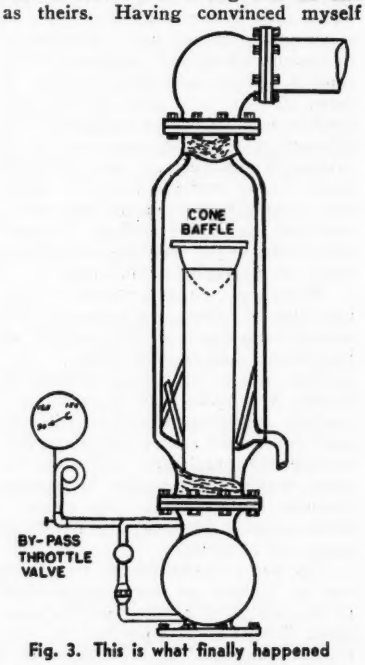


Fig. 3. This is what finally happened

that it wasn't the automatic shut-off valve, I had reached the conclusion that the trouble lay in the valve setting.

It remained for the regular day engineer, a rookie of less than a year's experience, to suggest that the trouble might possibly lie in the separator. He recalled that 3 days before the accident, when bringing the engine on the line, that he had heard something rattling in the separator. Recalling one time when I had to open a separator because the trap on it could get no water and found a boiler man's jumper covering the opening, I at last conceded that there might be something to the rookie's idea. An accurate gage was placed on the connection to the by-pass throttle valve, and the engine started. The pressure drop across the separator fluctuated between 25 and 60 lb.

We dismantled the separator and found the cone-shaped baffle completely down. Originally, as shown in the accompanying sketch, Fig. 1, the cone had been anchored by three ¾-in. rods run through ¾-in. pipe, with nuts screwed up tight to make it rigid. For 3 or 4 yr., or since the engine began to fail to carry the load, the baffle had evidently hung by a single rod, as shown in Fig. 2, for only one of the rods showed a fresh break. All had

evidently been broken by slugs of water, as carryover was rather common in this plant. In stopping the engine so suddenly, the baffle, up-side-down when found, had evidently rolled into the position shown in Fig. 3, effectively sealing the separator outlet.

The Super Watzit

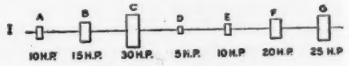
IT IS NOT OFTEN that our eagle eyes are privileged to drag forth from comparative obscurity, a development as astonishing or as far reaching as the one described here. We saw it first in a copy of "Ham Tips" from R. C. A., which is a small publication issued regularly by R. C. A. for the benefit of the radio amateurs—you know, those guys you occasionally tune in on your radio set who are always calling CQ, CQ. Well, anyway, there was this little item about the super watzit, tucked away in a little corner where only the keenest eyesight would ever see it. We saw it at once, of course, and instantly realized its implications in the defense program. A copy of the drawings of the super watzit, we feel, should be in every drafting room file in the country. We immediately took up the matter with R. C. A. and asked their permission to republish the item on the super watzit in the Practical Engineer section, which they graciously extended. We haven't mentioned the matter to Pulverizer Pete or our Hero guy, and now that the cat is out of the bag, so to speak, we are beginning to shudder at the probable consequences. We are dreadfully afraid, Pulverizer Pete will attempt to make one of these gadgets or improve upon it. And if our hero attempts to make one, think of the headaches he is going to pass on to us because we know he won't be able to make it work. It is not like us, however, to let personal inconveniences stand in the way of our patriotic duty—in the interest of National Defense we feel it our duty to present this startling invention to the world regardless of all consequences. Drawings of the super watzit, skillfully mixed in with drawings of bomb sights, range finders, radio beams, submarines, etc., will certainly be found by the fifth columnists, looking for inventions to pass on to the enemy, and think of the endless confusion it will cause when they try to figure it out. Think of the Gestapo boys drawing red lines in midair. Think of Mr. Goering trying to adapt the super watzit to his Luftwaffe.

One warning, however. If any of you decide to make a super watzit and find yourselves drawing red lines in midair, don't call on us for help. Don't expect us to tell you how to make it work. By presenting it here we feel that we have done our duty and forthwith wash our hands of the whole business.

Is Your Line Shaft Properly Driven?

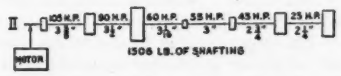
By W. F. Schaphorst

FEW operators of line shafts, believe it or not, know that there is a BEST way in which to drive such shafts.

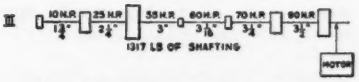


There are many WRONG ways, of course, but only *one* best way. By doing it properly the cost of power and the cost of shafting can both be considerably reduced in many instances. It is accomplished by placing the driving motor or main driving pulley of the line shaft in its correct place. The sketches herewith show how this is done.

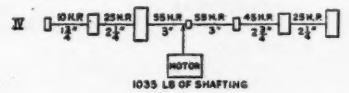
The pulleys on lineshaft marked I, above, are 10 ft. apart. Pulley A will transmit 10-hp.; B, 15-hp.; C, 30-hp.; D, 5-hp.; E, 10-hp.; F, 20-hp.; and G, 25-hp. respectively, with a shaft speed of 200 r.p.m. The problem is to place the motor in the position that will require least weight of shafting and that will cause least power loss due to friction.



Sketch II, above, shows the sizes of line shafts required between the pulleys to transmit the quantities of horsepower with the motor or driving pulley at the extreme left end. The minimum size of shaft is 2¼ in. at the right end and the maximum size is 3⅝ in. at the left end.



Next is sketch III which shows the sizes of shafting required with the drive at the extreme right end. This time the minimum size of shaft is 1¾ in. and the maximum size 3½ in.



And finally, Sketch IV shows how to determine the correct position: Work inward from both ends and place the motor on the "maximum" size of shaft. The maximum size here is 3 in.

Computing the weights of II, III, and IV, it will be found that with 10 ft. between each pulley, 1506 lb. of line shafting will be required for line II, 1317 lb. for line III, and 1035 lb. for line IV. In other words, line II requires 45 per cent more than line IV and line III requires 27 per cent more than line IV.

Obviously, line IV will absorb least friction because the smaller the shaft the less the surface speed, and consequently the less the power loss. That is an important advantage. Another important advantage is that the bearings for the smaller line shaft sizes will cost less, which is particularly true where it is decided to use anti-friction bearings as is so commonly done these days.

Flexible Lead for Mercury Switch

By James P. Marshall

WITHIN A MERCURY-TUBE switch, the constant rocking of the tube repeatedly caused the flexible wire lead to break, making annoying delays in production.

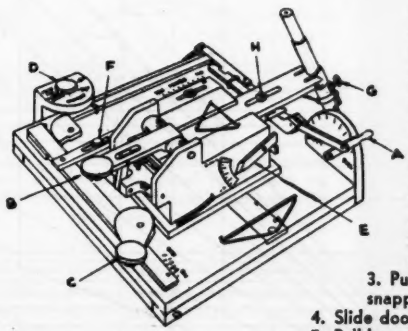
The difficulty was finally remedied by taking a suitable length of ordinary pull-chain from a discarded socket and soldering terminals to each end, then installing the chain in place of the flexible wire lead.

The small currents are carried by the chain-lead quite effectively and the extreme pliability of the chain has definitely stopped any further breakage.

SUPER WATZIT

Automatic Checking Machine Completely Portable, Adjustable, Demountable & Wreckable

(Patent not applied for)



DIRECTIONS

Before operating the checker, see that all gadgets are in normal position — all indicators should be set at 6⅝ except levers A, C, D and E which will be at full, on, danger, and up respectively.

To operate—

1. Place Watzit in such a position that the intersection of cross-hairs in sight is superimposed upon one thing or another.

2. Push lever "A" to left until it points to empty.

3. Push down on button "B" until snapping of catch is heard . . .

4. Slide doodad "C" to your left.

5. Pull lever "D" up toward down and Watzit is ready for another operation.

Knob "D" is for operating erasing mechanism. However, since there is no such thing, this knob will be referred to as dummy. To change length of down stroke, move screw "H" in any direction. To change angle of upstroke, loosen any screw and slide pivot "F" to or fro. If pencil point melts, remove by loosening screw "B" . . . since this is a class 5¼ fit . . . and cockeyed at that.

Important—Never operate button "B" with "A" in "Full" position or Watzit will draw a red line in midair!

WRAP—A Further Consideration of the Subject

By Charles Hubbard

IN THE well written article by W. F. Schaphorst in the October issue, data and sketches show the rapid increase in tension difference between the tight and slack ends of a belt or brake-band as the number of wraps increases.

The effect of wrap (and also friction) can be shown in another manner. If the data are plotted on semi-logarithmic ruled cross-section paper the points will lie on a straight line. This paper has a uniform scale on the base and a logarithmic scale on the ordinate.

The rational formula for calculating the difference in tension between the tight and slack ends of a cord, belt or brake-band that wraps a cylinder is given in several forms, all of which give the same answer if proper and consistent units are used.

In one form the formula is given as:

$$T = t \times e^{fxb}$$

Where

T = Tension on tight end

t = Tension on slack end

e = 2.718 a constant (base of Naperian Logarithms)

f = Coefficient of friction between surfaces

b = Arc of contact in radians

$$= 2 \times 3.1416 \times \frac{A}{360} = 0.0175 \times A$$

Where A = Arc of contact in degrees

If this formula is used to obtain points for plotting on semi-logarithmic paper only two computations are necessary for each value of friction selected. If the values for the two points are correctly calculated and plotted, a straight line extended through the points will intersect the base at zero degrees of wrap and at unity on the tight tension scale on the ordinate. A family of curves, each for a different friction factor can be plotted on one sheet of paper, and all curves will radiate from the zero-unity point on the base.

To obtain points for plotting a family of curves, computations are not necessary. Tables that give values of e^{fxb}, for a wide range of wrap and friction factor can be found in text and handbooks. One such table that is convenient to use is shown in M.E. Handbook (Marks), page 248, Ed. 1; 250 Ed. 2.

When plotting values of e^{fxb}, the base can be selected for any desired unit—angles or wrap or radians, but angles is the most convenient unit to use. Select the value of e^{fxb} for the maximum angle of wrap for the first point of plotting, and some intermediate point (say half of the first) for the second point and again a straight line through the points should intersect the base at zero-unity.

The curves show for a given angle of wrap the value of the tight tension side increases rapidly when the friction factor is increased. For 360 deg. of wrap the value of T for 0.50 friction factor is 12 times greater than the value of T for friction factor 0.10.

Care must be exercised when interpolating between the friction factors; remember this is a logarithmic scale and not a uniform scale.

The difficulty of using this formula is in the selecting of the proper value for the coefficient of friction. The only recourse for those who are not specialists in this branch of mechanics is to go through the various handbooks and select a value they "think" fits their particular problem.

The use of this problem is not limited to tension problems—it applies to all problems in which one unit increases in arithmetical progression while the other unit increases in geometrical progression. In nature it is the organic rate of growing.

In another form b^{-at} it is the "die away" curve; and in another form it is the compound interest formula.

I have found only one text book that gives a full "step by step" derivation of this formula in terms of elementary algebra and trigonometry. Most of the derivations were of type "it is obvious" or resorted to the use of calculus. The reference is Mechanics, by John Cox (McGill University), Cambridge (University Press) 1909; page 200.

Table Used in Plotting Values of e^{fxb}. This table can be found in Marks' Mechanical Engineers Handbook. (A = Angle in Degrees Subtending Arc of Contact)

		Values of e^{fxb}								
	A	f								
A	360	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
90	.25	1.17		1.37		1.60		1.87		2.20
180	.50	1.37	1.60	1.87	2.20	2.57	3.00	3.50	4.10	4.80
360	1.00	1.87	2.57	3.50	4.80	6.60	9.02	12.35	16.90	23.14
720	2.00	3.50	6.60	12.35	23.15	43.38	81.30	152.40	285.68	535.50
1080	3.00	6.60	16.90	43.38	111.32	285.68	733.14	1881.5	4828.5	12,391
1440	4.00	12.35	43.38	152.40	535.49	1881.5	6610.70	23,227	81,600	286,744

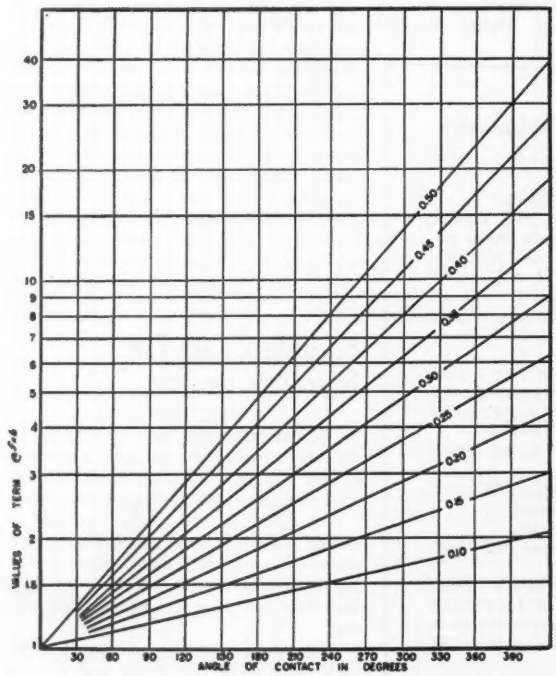


Fig. 1. Values of the term e^{fxb} for use in formula. Diagonal lines are values for coefficient of friction. Angle of Contact in Degrees

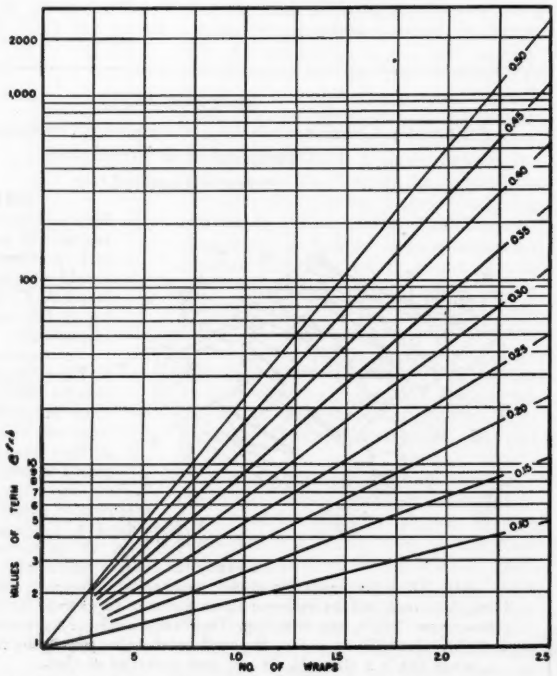


Fig. 2. Values of the term e^{fxb}. Same as Fig. 1 but with the angle of contact in terms of number of wraps

THOSE EXPLOSIVE RIVETS

THERE HAS BEEN a great deal of interest during recent months in the explosive rivets being used in the manufacture of airplanes and while they have been given considerable publicity, many still do not understand the details of their construction. While they are simple in form and principle, these rivets have been the subject of considerable investigation in the course of their development. Aside from the speed at which they can be set, their peculiar advantage over ordinary rivets is in the fact that they can be set "blind", that is, they can be set from one side of the work.

As shown in the accompanying illustrations, the explosive rivets are similar to ordinary rivets except that a high explosive is contained in a cavity at the end of the shank. Heat applied to the rivet by an electric gun (similar to a soldering iron) detonates the charge. The explosion expands the charged end of the shank, thus forming a "blind" head and setting the rivet.

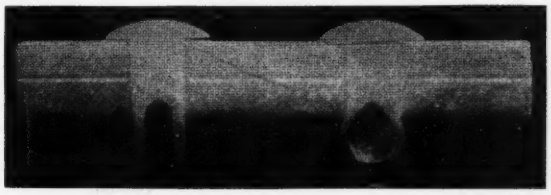


Fig. 1. Cross sectional view of two explosive rivets. One, left, is ready for firing, with shank cut away to show position of the charge. Right, the result of firing (Photo, Du Pont Magazine)

The whole operation is performed from one side with greater ease and speed than is possible by any mechanical means previously used in aircraft plants.

These rivets are now being manufactured in commercial quantities by E. I. du Pont de Nemours and Co. and while they are being used now only in the aircraft plants, it is probable that they have application in many other industries. Once they are in place the Du Pont rivets can be installed by one workman at a rate of 15 to 20 rivets per min.

No wadding or other confinement for the explosive is needed in these rivets; the end of the shank is left open. So finely has the explosive charge been controlled, however, that the expansion it effects may be held within limits of 0.020 in. The Du Pont Riveting Iron is a silver tipped electrically heated tool held against the head of the rivet after it has been placed in the hole.

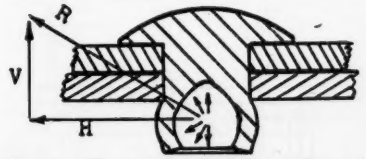


Fig. 2. All components of force directed toward the machine-formed head help to compress the shank with some tightening of the assembly parts

Strangely enough, and like many other inventions, although brought over from Europe, the explosive rivet was initially an American invention. In 1921, an American, Frank Allan, patented several types of explosive rivets and bolts that, he hoped, might prove the solution of the blind rivet problem. His rivets did not prove commercially feasible. In 1937, however, a patent issued by the United States Patent Office to Karl and Otto Butter, two brothers employed by Ernst Heinkel, builder of the famous German plane bearing his name, revived the idea of setting "blind" rivets by expanding the shank with a minute explosive charge.

Early in 1939 the Du Pont Explosives Department became interested in the idea and began seriously to explore its possibilities. From the outset the Butter rivet seemed to offer advantages over any of the existing types of "blind" rivets and to have great promise, provided it could be further perfected and economically manufactured. At this time Europe was at peace. Accordingly, the North American rights to the invention were purchased from the American Explosives Rivet Co., whose owners had previously acquired them from Heinkel.

At present the rivets are being manufactured of an aluminum alloy. Of varying diameters and sizes to meet structural requirements, they are of the modified brazier head and countersunk types, the latter permitting the flush riveting required by modern high speed planes. Several million explosive rivets have been sold since their development. From 800 fastening points in an all-metal pursuit plane to as many as 10,000 in large bombers are accessible only from one side.

Fig. 3. A riveter at work. When a rivet reaches a temperature of 130 deg. C., there is a moderately loud explosion and the shank expands to the barrel-shaped closing head shown in Fig. 2 (Photo, Du Pont Magazine)

Power of the Sun

By W. F. Schaphorst

WHERE will the power plant of the far future obtain its power? We frequently read about the enormous power transmitted to the earth by the sun. There is considerable difference of opinion amongst authorities as to just what that power is. I would like to know the exact quantity myself. For example, the following was written by the late Col. E. D. Meier, boiler manufacturer and president of the A.S.M.E.

"Remembering, then, that this sun-energy reaches us only one-half of each day, we may, whenever we learn how, pick up on every acre an average of 175-hp. during each hour of daylight, as a surplus which nature does not require for her work of food making."

In a paper recently read before the American Chemical Society, Henry L. Doherty, calculated the sum to deliver 6160-hp. per acre to the earth.

Robert T. Aitken of the Lick Observatory says:

"Every acre of the earth's surface which is exposed to the vertical rays of the sun is constantly receiving energy at the rate of 4000-hp."

All of this is interesting, and I am sure other readers would like to know more about the actual energy transmitted to the earth per acre. It is estimated that the sun is continually radiating into space 1,000,000,000,000,000,000,000,000 hp.

Ed. Note: The so-called "power of the sun" is a relative term and there can be no definite answer to the question, "What is the power of the sun?" From measurements of the temperature of the surface of the sun and from other astrophysical data it is possible to arrive at some estimate of the total amount of energy radiated by the sun; whether this is Mr. Schaphorst's 1 followed by 24 zeros, or some other equally incomprehensible figure does not matter because the proportion of the total amount of energy that can be captured by the earth at a distance of 92 million miles is absurdly small. As to the amount of the sun's energy falling upon the earth's solid or liquid surface, that varies tremendously depending upon the latitude, the season, the conditions of the atmosphere, etc. To say that every acre of ground is capable of absorbing an average of 175-hp. may be correct, though the chances are that it isn't, but even if that were the average for the earth as a whole, the information is quite as useless as if the figure was a pure guess. What is of importance is how much energy the sun delivers to particular portions of the earth's surface under certain conditions. While it is possible that some particular means may be discovered for converting the electromagnetic radiation of the sun directly into energy useful to man, a very good method using an intermediate step in the process is available today, i.e., in the conversion of organic materials into alcohol.

Questions And Answers

141

His Watch Gets Magnetized

Q. I wonder if the Questions and Answers department could help me out with a little problem I have encountered in my work. It is necessary for me to be around direct current generators all the time and as a consequence my watch becomes magnetized. It is an expensive proposition to be running to the jeweler all the time and I wonder if you or some of the readers of the Practical Engineer section could tell me of some simple way of taking the magnetism out. Could I build some sort of a transformer to take it out? I once saw an article on this subject, but it is so long ago I have forgotten where it was.

LOUIS SCHAEFFER
Rochester, N. Y.

142

How Can Short Circuits in Underground Cables Be Located?

Q. I am wondering if the readers of Practical Engineer can help me out on the following problem:

My company has installed quite a lot of two and three wire No. 6 lead cable which is from 12 to 16 in. under the ground. This cable operates at 120 v. a.c. It has a steel tape which covers the lead sheath and the whole is covered with a jute wrapping. My problem is to locate grounds and short circuits in this cable without digging up the street from one lighting standard to another.

I wonder if any readers can suggest any method such as a coil and head set that could be carried above the ground over the cable to detect a pulsating current in the cable to the fault. The telephone company has such an instrument, but the coil to the head set must rest against the cable to detect the current. This is fine for aerial cable but does no good underground.

This cable is used for an underground multiple street lighting system. I will appreciate any suggestions along this line of some inexpensive means of locating these faults without digging till I find them.

London, Ohio D. M. MUSTARD

143

Solid Equivalent of a Stranded Conductor

Q. How can I determine the equivalent size in a solid conductor of a stranded wire? As an example, what is the solid conductor equivalent of a stranded conductor with seven No. 12 wires? The wire tables do not give this and I wonder whether anybody could refer me to a formula by means of which I could calculate it.

Lynchburg, Va. JACK ADAMS

144

What Is the Collapsing Pressure of a Condenser Tube?

Q. What is the collapsing pressure of a No. 11 gage seamless steel condenser tube?

Realizing the different hardness or tensile strength of different tubing, this question pertains to a soft steel ammonia condenser tube but this, of course, would be merely a matter of substitution in the equation. None of my reference data seems to have this data and I wonder if somebody can give it to me.

Also, to complete this question, any formula to solve for internal bursting pressure would be of interest.

San Francisco, Cal. O. H. N.

145

How to Figure Tonnage of Brine Cooler

Q. What is the simplest way to figure the tonnage of a brine cooler? The following data is available:

Brine temperature from cooler, 9 deg. F.

Brine temperature to cooler, 15 deg. F.

Brine flow, 1200 g.p.m.

A. DANIELS
Jackson Heights, L. I., N. Y.

146

Testing for pH

Q. What are the customary methods used in testing boiler feedwater for pH? I understand that several methods are available and I would appreciate information from others who have used these methods or are familiar with them.

Holyoke, Mass. ALLEN S. HUNTER

147

Steam Stacks for Cupolas

Q. Brother Irenaeus, C.S.C. of the University of Notre Dame, is interested in knowing something about steel plant cupola steam stacks. What steam pressures are used and what is the relation between the capacity of the stack and cupola sizes? Also what are the quantities of steam used in relation to pig iron quantities? Similar data for steam stacks used for sugar beet vats is requested.

These are rather unusual questions and if any of the readers of these columns can give us information on them, we are sure that Brother Irenaeus will be grateful.

148

How Can He Prevent Carryover?

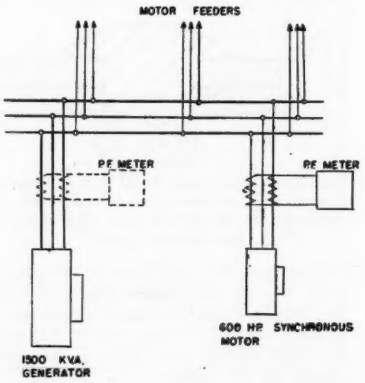
Q. We are operating a 100-hp. H.r.t. boiler and when the safety valve lifts, water is pulled over into the engine. The traps do not seem to be able to take care of this water and we are wondering if it would help us any if we installed a baffle under the dry pipe. Any comments or other suggestions on this condition will be welcomed.

Quincy, Ill. CLYDE WITTEMEYER

149

Power Factor Meter Reading

Q. We have a power factor meter installed on a 3-phase 440 v. line leading to a 600-hp. synchronous motor as shown in the accompanying diagram. In a discussion of this arrangement, one of the operators contended that this meter reads the power factor of the generator, a 1500 kv-a. machine. I claim that the meter reads only the power factor of the line leading to the motor.



Who is correct? The rest of the load on the generator consists entirely of induction motors.

Suppose the power factor meter were connected in the generator leads as shown by the dotted lines; would

the meter then indicate the power factor of the system as a whole?

Ann Arbor, Mich. J. V.

A. A power factor meter reads the power factor at the point at which it is connected. In your diagram the power factor meter connected in the motor circuit will read the power factor in the motor circuit only, as the power factor of the generator is the resultant of the power factor in the 600-hp. synchronous motor and in all the other motor circuits. When the meter is connected in the generator leads as indicated by the dotted lines, it will measure the power factor at this point. This is, in effect, the generator power factor. If the generator is operating alone, that is not in parallel with other generators, the meter will indicate the power factor of the system as a whole.

150

What Are "Corwel" and "Dawson" Joints

Q. Can you give me any information on "Corwel" and "Dawson" joints as the terms are used in piping layouts? Recently I came across two instances in which these joints were mentioned but I can find no reference to them in any of the literature I have available.

Clifton, N. J. A. PARIS

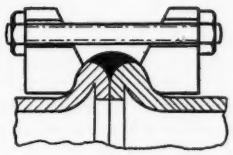


Fig. 1. Corwel Joint

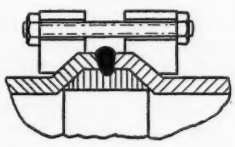


Fig. 2. Dawson Joint

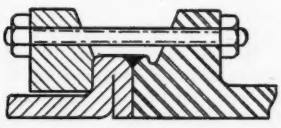


Fig. 3. Loose Corwel. Cast Corwel

Fig. 4. Fixed Corwel

A. The "Corwel" and "Dawson" joints are high-pressure steam and water joints which are widely used in England, in English power station practice. The terms are not used to any extent in the United States to our knowledge.

The "Corwel" joint is shown in Fig. 1. This, as can be seen, is a welded joint with the strain held by specially designed loose flanges and bolts. The ends of the pipes are turned inwards.

The "Dawson" joint is shown in Fig. 2. In this case the pipe ends are butt welded over an inner ring and the whole thing held tight by the external flanges.

There are several variations of the Corwel joint. In Fig. 3 are shown the loose Corwel and the cast Corwel while in Fig. 4 is a section of a fixed Corwel.

As in comparable American practice, it will be evident that in all these joints, the weld serves only as a seal to ensure steam tightness. The actual stress is carried by the bolts and the external flanges.

THE BEST WAY OF FINDING THE HEIGHT OF YOUR SMOKE STACK

In a nice letter which we received from one of our readers in Los Angeles, who signs himself S. E. W., he relates an anecdote, as he calls it, which in our opinion is too good to remain buried in our correspondence file. So, here it is, in S. E. W.'s own words:

"At North Dakota University, my alma mater, a sophomore class in surveying was conducted by the, then, Dean of the College, E. F. Chandler. The Dean was a master of the art of making bull sessions pay educational dividends. One afternoon, long after the class was officially dismissed, he asked each of us the best way to find the height of the smoke stack at the University power plant. The solutions, including mine, were marvels of trigonometric intricacy. Mine, unlike some of the others, required only one transit, one man to leer through same, a tape, and a couple of chainmen.

"When he had heard us through, the Dean sat in silent thought for a moment. Then gave forth:

" 'The be-e-est way to find the height of that stack is with a barometer. Climb the stack, lower the barometer on a string, and measure the string.' "

The moral implied in this answer is, of course, the necessity for simplicity in the consideration of any engineering problem.

The Dean's answer was a trick answer, designed largely to put a group of students imbued with the fervor of a little technical knowledge back on their feet where they belonged. Only few questions call for trick answers, however. Those on the opposite page for example don't call for any trick answers. They are all questions that have been asked by readers of this section and all represent real problems. Some of them are comparatively simple and easy to answer; others are more difficult or call for specialized knowledge. In all cases, however, you—the readers of this section—are invited to answer them. In doing so you will be helping others who are not blessed with your knowledge and in any case your opinion will be interesting to others. If you can solve some of these problems by tying a barometer on a string, so much the better, but send us your answers.

A. 98

What Happens When Condensate Pump Stops

Editor's Note: In the February issue, H.B.K. asked a question regarding the operation of his new 500-kw. condensing turbine in the event that the condensate pump stopped. He felt that the condenser would fill with condensate to the ejector inlet pipe, that the ejector would not work and that the vacuum would break. Under these conditions the turbine would run non-condensing, even though the cooling water was flowing through the condenser. Others had told him that the condenser would fill with water to the turbine and that it would tear out the last row of blading, but H.B.K. could not agree with this opinion.

Many readers replied to this question, and in all cases they agree with H.B.K. that he need not worry about damage to his turbine. Two of these replies were published, R. S. Julsrud's in the May issue and Carl E. Smith's in the July issue. Among other answers mailed direct to H.B.K., but which up to now we had no opportunity of publishing, are the two following letters by Donald Osterhoudt and George Bruning, respectively. Both of these answers, while agreeing with H.B.K., nevertheless point to conditions in the operation of the unit which should be of interest to everybody in charge of condensing turbines.

A. In 1932 we had a 300 kw. turbine installed similar to H. B. K.'s 500 kw. condensing type turbine. About 2 mo. ago we made the first repairs on

the condenser. Three tubes that were leaking were replaced and a new set of nozzles was put in the ejectors.

During the length of time that this unit has been in service it has gone on back pressure a number of times because of failure of either the condensate or circulating pump.

Judging from the experience that we have had with our unit, H. B. K. need not worry about damaging the condenser when his unit goes on back pressure due to failure of either of its auxiliaries, provided that the atmospheric relief valve on the condenser is in working order. I find that the damage is apt to be done when you start up the auxiliary which has failed without shutting down the turbine. When the condensate pump fails, the tubes are liable to be ruptured during the time it takes for the pump to clear the water out of the condenser and the condenser picks up its vacuum again. When the tubes, which are full of cold circulating water and covered by condensate, become suddenly exposed to the exhaust after the pump is started up again, the condenser will grunt and groan like a boiler when the water is low and cold make-up is fed into it.

The same thing holds true when the circulating pump fails and you start it up and force the cold water through the hot tubes which are surrounded by exhaust steam. This does not happen when the pumps fail because then there is a gradual change in temperature while the vacuum is dropping.

H. B. K. is quite right in saying that the turbine will run on back pressure when the condensate pump fails and the cooling water continues to flow through the condenser and he need not worry about the condenser filling up with water to the turbine and tearing out the last row of blading as long as the atmospheric relief valve is in working order. The only places that we have had any trouble with water are the steam nozzles and the blading in the first stage and that is because wet steam is being delivered to the turbine.

The turbine can be run on back pressure if either one or both of the auxiliaries stop, but he will find that the turbine, if it is a straight condensing type, will only carry about ⅓ of its rated capacity when on back pressure and that the fireman will sweat blood trying to keep the steam pressure up.

Always be sure that the atmospheric relief valve is in working order because if it ever lets you down at the wrong time almost anything and everything can happen at the same time.

DONALD OSTERHOUDT.

Poughkeepsie, N. Y.

MR. BRUNING'S ANSWER

A. The condenser would fill with water to the steam jet air pump suction in the condenser, which is located about 2 ft. from the bottom of the condenser. When this opening is sealed with water it will be impossible to relieve the condenser of air and gases which will build up a pressure causing loss of vacuum. When vacuum becomes lost, the pressure rises to a point where it opens the atmospheric relief valve generally set at 5 lb. pressure.

The turbine, as soon as the vacuum drops, starts to use more steam to do the same work, and when the atmospheric relief valve opens, the quantity of steam being used will become so great as to be a serious drain on boilers supplying the steam, necessitating the shutting down of the turbine. Also condensers are built to withstand a low pressure, and if the atmospheric relief valve did not open, there is no doubt that the condenser would blow up.

The 1 in. drain in the atmospheric exhaust pipe would be too small to take care of the condensate. It would have to be the same capacity as the condensate pump, as the atmospheric exhaust pipe rises to top of building and does not drain to flow.

With regard to Question 2, when the cooling water pump stops, there is no way to condense the steam, the temperature in the condenser rises too, essentially the same temperature as the steam, the condenser space fills with steam, pressure rises as air pump cannot relieve condenser of air or gases, and at 5 lb. relief should open and turbine will run high pressure or non-condensing and drain the boilers. Also condenser tubes will heat up, packing at tube ends will dry out with the heat and leak until repacked. In surface condenser work the greatest work is done at the bottom rows of tubes as they are coldest.

When the cooling water pump, or circulating water pump as it is usually termed, stops operation, the water drains from the condenser through the pump, unless the pump discharge valve is closed immediately and if this valve were closed in time, the water left in the tubes would heat up, and have no cooling effect.

It is impossible to operate any condensing type turbine as a non-condensing turbine, as the turbine blading is not designed for such a condition.

The whole question boils down to one answer:

If you lose the condensate pump, shut down the complete unit at once —not only to save the machine but save lives as well.

GEO. L. BRUNING.

Collingdale, Pa.

A. 125

Well, Blow Me Down! What a Lot of Answers

Editor's Note: C.W.Z.'s weird blowdown system shown on page 92 of the August issue brought forth a large number of comments. Strange as it seems, it apparently is not new because some readers had similar arrangements and their comments on it should be of interest to many others besides C.W.Z. who submitted the diagram. Four of the replies are given below.

A. The problem presented by C. W. Z. under the above title in the August issue probably can be solved by forced circulation.

Many operators of H.r.t. boilers are installing pumps to overcome the sluggish circulation inherent in this type of boiler. A few years ago the Chestnut Hill Pumping Station of the city of Boston, Massachusetts, Water Department installed pumps on H.r.t. boilers and found that the circulation was greatly improved.

I understand that the pump takes suction at a point about 12 in. below the water level at the front end and discharges at the opposite end about 12 in. above the blowdown connection. Such an arrangement will keep most of the solid matter in circulation, but if the river water is unusually muddy, I would suggest the use of a settling tank or tanks before pumping to the boiler. The suction line to the pump should be provided with a swing connection inside the tank in order that the end of the pipe always can be kept above the sediment.

It seems quite obvious that the naturally sluggish circulation of the H.r.t. boiler should be improved by the use of a pump when one considers that greatly improved operation has been reported for water tube types of boilers (Loeffler, La Mont, Velox, Benson, Sulzer) using forced circulation. These are all European designs, but the day is not far away when American manufacturers will provide forced circulation as standard equipment.

Naperville, Ill. J. R. DARNELL

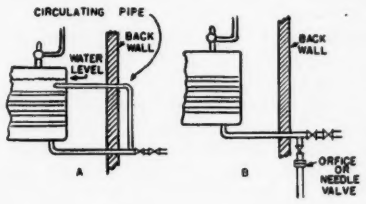
C.W.Z. in the August issue has some interesting questions on circulation, which can be answered as follows:

1. Circulation in a water column results from the steam condensing. Since water always seeks its own level, the condensate running down the water column and gage glass forces that same amount of water to circulate back to the drum through the water pipe. In the case of this blowdown pipe, there is some condensation in the outside pipe, but this is a small amount due to the short pipe. This hookup will not circulate like a boiler tube because one end of the circuit is too much above the water level, and the circulation head is not equal to that amount. The small amount of water that can circulate is not enough to protect the blowdown pipe and remove the heat input, thus the pipe overheats, the sludge bakes on, and the pipe corrodes.

2. The blowdown should certainly be protected from the hot gases.

3. Using river water as feedwater depends entirely on the water. If it has much suspended matter, then C.W.Z. may be able to set up a sand filtration tank, pictures of which

have appeared in POWER PLANT ENGINEERING. Depending on the type of suspended matter, a coagulant may be needed. If C.W.Z. has had no trouble previously with no treatment, then he may be able to continue, since many other plants use river water directly.



4. If C.W.Z. wants a circulating system, he can get it by drilling the drum shell just below the water level and connecting the upper pipe there as shown on sketch A. A better system would be to install a continuous blowdown shown on sketch B. This will not only save considerable heat and water by requiring a smaller blowdown, but will also afford some continuous circulation in the blowdown pipe. Install in this line either a needle valve or an orifice for control. A valve is preferable, but if you use an orifice, you may have to play with several sizes to get the right one. Start out with an ⅛ in. orifice. In any event, the blowdown pipes should be protected to decrease the heat absorption.

5. The best way to treat your boiler water only a feedwater consultant can tell from an analysis of your water. Don't try a certain treatment just because a similar plant uses that treatment. It pays to spend a few dollars now for a consultant rather than spend more later with scale, burned out tubes, priming, plugged steamlines, loss of capacity, etc.

Staten Island, N. Y. R. ATLAS

The hookup, as described in the August issue of POWER PLANT ENGINEERING is not entirely new, as I once had charge of a similar arrangement where the so-called circulating pipe was used as a drain for the main header which was lower than the boiler outlets and also lower than the lines to the engines.

Question 1. Your hookup is exactly like a water column. You should have a valve in the 1 in. pipe and it should be closed each time you blowdown. Probably the lack of this valve is where your trouble is.

Question 2. Frequent blowdowns may eliminate the need of covering on the blowdown pipe; but it is better to protect the pipe from the direct products of combustion, and it should be remembered that each blowdown is a loss of heat units which means just so much more fuel.

Question 3. River water is usually soft water and quite suitable for feedwater. It is much better, however, to have a good double filter in the line of the stocking type, and the stockings should be washed regularly.

Question 4. Mud and scale will collect in the pipe regardless of the outside protection. With your hookup the flow of steam through the circulating pipe when you blowdown reduces the velocity of water through the pipe and you get no scouring action.

Question 5. The best way to treat boiler water in a plant, large or small, is to have your insurance company analyze the water and recommend the treatment.

Troy, N. H. ERNEST W. BLISS,
Chief Engineer,
Troy Blanket Mills.

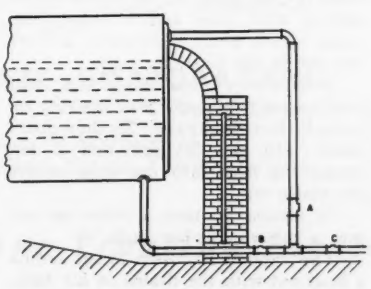
The best blow-off cocks are the asbestos packed, iron-body plug cocks, which are durable and safe. A globe valve should never be used in a blow-off pipe, because the scale and dirt will lodge in it and prevent its being closed tightly. A straight way, or gate valve, is not so bad, but an asbestos packed plug cock is undoubtedly the best and safest.

In order to protect the blow-off pipe from the intense heat, a shield consisting of a piece of larger pipe can be slipped over the vertical part before it is connected.

Blow-off cocks should be opened for a few seconds once or twice a day, to allow the scale and mud to be blown out. If neglected too long they are liable to become filled with scale and burn out. A plan which is said to give good results is to connect a tee in the horizontal part of the pipe, and from this tee run a 1 in. pipe to a point in the back head at the water level. It is claimed that this will cause a circulation of water in the pipe and prevent the formation of scale.

A surface blow-off is a great advantage, especially if the water is muddy or liable to foam. By having the surface blow-off connected on a level with the water line a large amount of mud and other matter which is kept on the surface by the constant ebullition can be blown out.

A combustion surface blow-off, bottom blow-off and circulating system can be arranged by a connection such as I will illustrate with enclosed drawing.



By closing cock A and opening cocks B and C the bottom blow-off is put in operation; by closing B and opening A and C the surface blow-off is started, and by closing C and leaving A and B open, the device will act as a circulating system. The pipe should be ample size, never less than 1¼ in., and from that to 2½ in., depending upon the size of the boiler.

1. No, it is not a circulating system; you get pressure from above which is steam, no condensation at all at this point. Horizontal top pipe should be at the water level, then it will circulate.

2. Yes, by all means the vertical one especially.

3. No.

4. Not much if blown down regularly, and hardly any if made a circulating system. (The right way and good water.)

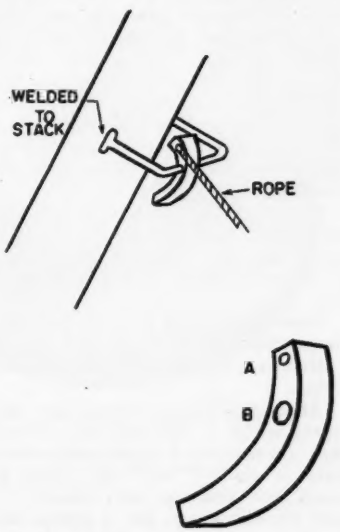
5. Take about seven samples of water out daily for a week. See water treating companies in POWER PLANT ENGINEERING.

G. C. HALLQUIST
Chicago, Illinois

A. 126

Coal Feeders Clog Up

A. In answer to R.A.J.'s problem. A simple remedy for the clogged feed pipes try this: Take a piece of flat iron and bend it to a half moon shape. A rough sketch is made at bottom. Drill two holes at one end as at "A" & "B."



At A is tied a stout piece of rope and at B is pinned to a suitable bracket welded to the pipe. When the pipes start to clog merely grab the rope and a few sharp pulls will act as a hammer and free the coal. There are electric vibrators on the market that act by the push of a button, but of course this is more elaborate and expensive.

Baltimore, Md. CHAS. W. PARKS

LETTERS AND COMMENTS

O, WOE IS US!

DEAR ED:

Perhaps you remembers how a long time ago——maybe 4 or 5 yr.—you writes a article on how to write a article for P.P.E. And I guess you remembers too (how could you forget) how I writes a article for you about how to build a boiler. Which article of mine leads to lots more articles of mine until we is now at the point where we both realizes that them contributions I makes is what keeps P.P.E. on its feet.

Now, if you permits me to tax your brain a little more—does you recall how I tells you where I has got a job sweepin' up in a power plant—which job is O.K. until you publishes my article about my Modern Safe Firing Steam Generator. So the power plant bosses reads this story about my invention and immediately recognizes the product of genius (me). So right away quick they chucks out all the boilers they got and starts building modern generators like I writes about.

One of the big shots comes to me and says: "Pete, on account you is such a wise guy, we is gonna put you in charge of these here new generators."

Now this is kinda nice, but I knows the possibilities of them generators and I declines, which means no thanks, or nix.

About this time I gathers from the papers which I ain't read for a long time (remember I does read) that there is another war on. Now it seems that this war ain't exactly to save the democrats, but it seems like we gotta make the world safe for Winnie the Moocher so Frankie and Joey can be sweethearts. (If J. Edgar Hoover reads this I'm only fooling on account he has got my fingerprints.)

So I figures some and comes to decide that I should offer my inventive talent and outstanding ability in many fields to one of the most defensive of the defense industries. Which figurin' ends up by me gettin' a job in a boat buildin' joint where they builds destroyers and cruisers and maybe row boats.

Now right away you is probably gonna fly off the handle and holler: "You has deserted the flock we don't wanta hear from you no more." But maybe you better read some more and then you realizes how much I is still in a cloud of flue gas and steam.

The first job I gets is to manicure a boats bottom for to get the barnacles off. This has gotta be done on account if a lot of barnacles on a boat tries to swim one way while the boat tries to swim the other way the boat gets slowed up and the barnacles they gets disappointed. Thus they is best off, off.

So I starts in scrapin and pretty soon I comes across a little hole in the boat. This worries me a little but I keeps on scrapin. Then I comes to a couple a big holes in the boat. This worries me a lot.

"Huh," I muses, "sabotage." Now I know and you probably guesses that I ain't a naval architect. But we both knows that if a boat has got a hole in the bottom it's gonna leak and if it keeps on leakin its gonna sink, which ain't what its for unless it's a submarine which I can tell this one ain't because it ain't gotta number like S-47.

"Already," I says to myself, "I has got a chance to be a silent and unsung hero." I don't bother askin' questions, I just gets me a weldin outfit nobody ain't usin and I seals them holes, which some subversive activity has cut in the boat, up tight.

Now things goes along O.K. and pretty soon this boat I was working on is ready to swim again. So they pours water into the drydock and a tug yanks the boat into the river where she starts out.

In almost no time I looks up and sees a tug yankin her back.

The captain is cussin about sendin a boat out with the drains in his bathroom clogged, the bos'n is kickin about how the salt water showers don't squirt and the engineers is moanin about condenser pumps not pickin up suction et cetery and so forth.

So the water gets emptied outa the drydock again and when they sees the bottom of the boat there is a lot of excitement. I hears talk about "condenser water inlet plugged, this plugged and that plugged, deliberate attempt to cripple ship. . . ." but nobody thinks to thank me for patchin up the holes.

Now I sees there is some big shots around so I figures it won't do me no harm to mention about the patchin, which I does.

Everybody's mouth opens up when they hears my story and a engineer picks up a big iron bar and starts in my direction. I don't like the look on his face, but somebody stops him. Maybe he was the guy what cut the holes in the boat—I don't know. Anyhow, some of the big shots talk to me quiet like and a guy in a white coat asks me a lot a silly questions.

Then one big shot says he is gonna reward me by givin me a job in the engine department where I will feel more at home on account of my power plant experience.

All I gotta do to start is empty the trash baskets and polish the cuspidors, but you know me, Ed. I learns fast. In a little while, maybe next month, I will tell you all about engine rooms in boats which is the same like power plants on land only more complicated on account they got more machinery in less space.

The best way for to describe a boat engine room is it is a place where if one little pipe busts you gotta move ten other pipes, a generator, a steam engine, and a pair a overalls outa the way before you can get at it to fix it.

You probably remembers too how I tells you how I has worked in boat engine rooms at sea, which probably accounts for my bein so smart about boats already.

Also which reminds me of a poem I once writes which is a good thing for to close with.

POEM

To go to sea I once did hanker
So I shipped upon a greasy tanker
And could hardly wait till we weighed
anchor.
But now, even should a land job fill
me with rancor
Would I ever sail again? No thank yer.

Affectionately,
PULVERIZER PETE

Are Safety Engineers Leaning Over Backward?

TO THE EDITOR:

Doing extensive First-Aid training as an instructor for the past 3 yr. has made it possible to contact and observe the work of quite a large number of Safety Engineers and men doing part time safety work. In as

Stone QUARRY...

IN A SIX-INCH PIPE

MINIATURE "stone quarries" inside water pipes are expensive and unnecessary. The line from which the typical section pictured here was taken was long ago cleaned *while in service* to full inside diameter by the Nalco System — And is being *kept* clean in the same way.

Where unstable water must be piped . . . hot or cold . . . for steam, processing or drinking — Nalco Engineers have tested treatments that *permanently* end corrosion, incrustation and other unsatisfactory water conditions. Investigate the Nalco System for complete, economical water treatment service in your plant.

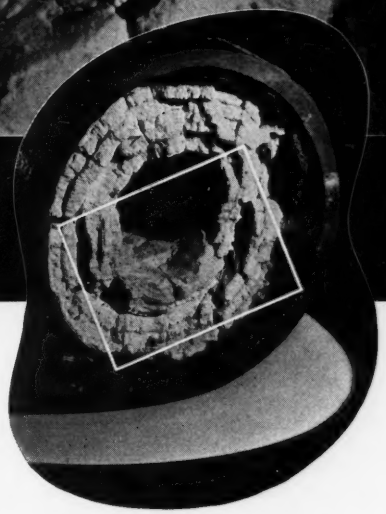


Photo in Nalco Laboratories.

(Large illustration is enlargement of area within white rectangle in inset photo.)

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place **Chicago, Illinois**

Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

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much as safety is of personal interest to each man in industry, it is hoped the following will be taken as constructive criticism.

When organized safety work was first introduced to industry it was not welcomed by all, due to the increased expenditures it would require to make machinery and working conditions acceptable to safety requirements. Reports compiled by the industries employing Safety Engineers soon disclosed the facts that millions of dollars were being spent for lost time accidents and deaths, which upon closer study proved many were caused by negligence, improper training of employes and some actually industrial murder. Realizing the accident frequency could be drastically reduced or even eliminated by safety study and training, many of the disinterested industries of the past became some of the strongest proponents for the promotion of safety in industry. Safety features of machinery were stressed, working conditions were improved to conform with safety requirements, Safety Engineers were hired or men were put on part time safety work to study how every phase of industry could be improved from the standpoint of safety. During this period safety hit new heights and a real inroad was made on lost-time accidents. Workmen were not permitted to use a scaffold until the Safety Engineer had OK'd it, hours were spent training men to operate dangerous machinery, guard rails and danger signs were literally piled on any point which might injure a workman, long study and records were made of minor lost-time accidents and precautions instituted to eliminate their reoccurrence. Although safety might have been pushed to the extreme during this period the reward was worthwhile for many injuries and deaths were avoided.

Then came the period of stabilized employment when only the oldest and safety-trained employes were able to hold their jobs. In many cases forces were cut so deep and the accident frequency became so low the Safety Engineer was either laid-off or assigned to productive work. Safety was still in force by virtue of the fact that the men holding jobs had been trained to work safely, but safety was no longer stressed with the same vigor which kept it moving before.

Today, due to the National Emergency, re-employment is out-racing even the briefest safety training programs of the most ambitious Safety Engineers of the true Safety Era. Safety in many cases today is being directed by "Poster Engineers" and not Safety Engineers, they seem to have lost the art of promoting safety by contact with employes. The occasional posting of an abstract poster or bulletin seems to fill the bill to qualify for many Safety Engineers' duties. The real responsibility of teaching and enforcing safety measures is left up to department heads, with the threat a lost time accident will be charged against them directly. The department head may see the Safety Engineer occasionally at a meeting and may or may not have a book of safety rules, but that in many industries is the only safety program which is being instituted today, it's not true safety training.

Safety is something personal, for few workmen will deliberately injure or kill themselves and it is one of the chief duties of the Safety Engineer to personally show the employe, especially the new ones, that his safety training is solely for his own protection. Cartoons of some make-believe guy hitting his thumb with a hammer or the like impresses a workman about like a cigarette ad, unless frequently the Safety Engineer comes around and refreshes the workman's memory that he must work safely, this is personal safety engineering which pays bloodless dividends.

A progressive Safety Engineer must be a super-salesman for he must sell a service to a client which is for the benefit and protection of both the client and his employer.

Safety Engineers may enjoy long accident free periods, and even become lax with their training, but these are troubled times when the employe's mind is allowed to wander from his work which is the best insurance an accident will happen, unless the progressive Safety Engineer hammers out the confusion with the constant chant of "Work Safely."

The most dangerous place to work today during this period of National Emergency and production speed-up is where the Safety Engineer is smothered with red tape or bookwork or where he sits behind his desk smoking a big black cigar replaying last night's bridge game and waiting for an accident to happen. He may have no time to train men, something else is more important to him.

A new face in the shop today may be a scarred face tomorrow, just because a Safety Engineer thought the new man could be trained later about the dangers of his job and the schedule for the golf tournament was already late.

To the progressive Safety Engineers these statements will indicate the course to follow, and soon others will notice and praise the fine work you are doing. Little respect is held by fellow employes for the Poster Engineer for they feel he has no personal interest in their welfare.

J. C. De Foe

After the War, What?

To the Editor:

No doubt the cause and effect of the present conflict can be summarized by the following lines:

"The blood of the noblest is lavished
that the selfish profit may find
But God sees the lives that are squandered, while we to his wisdom
are blind."

Regardless of the cause or its ultimate effect, the question that is of real importance to us today, aside from bringing the war to an early close, is what will we do when the war is over? Where do we go from there?

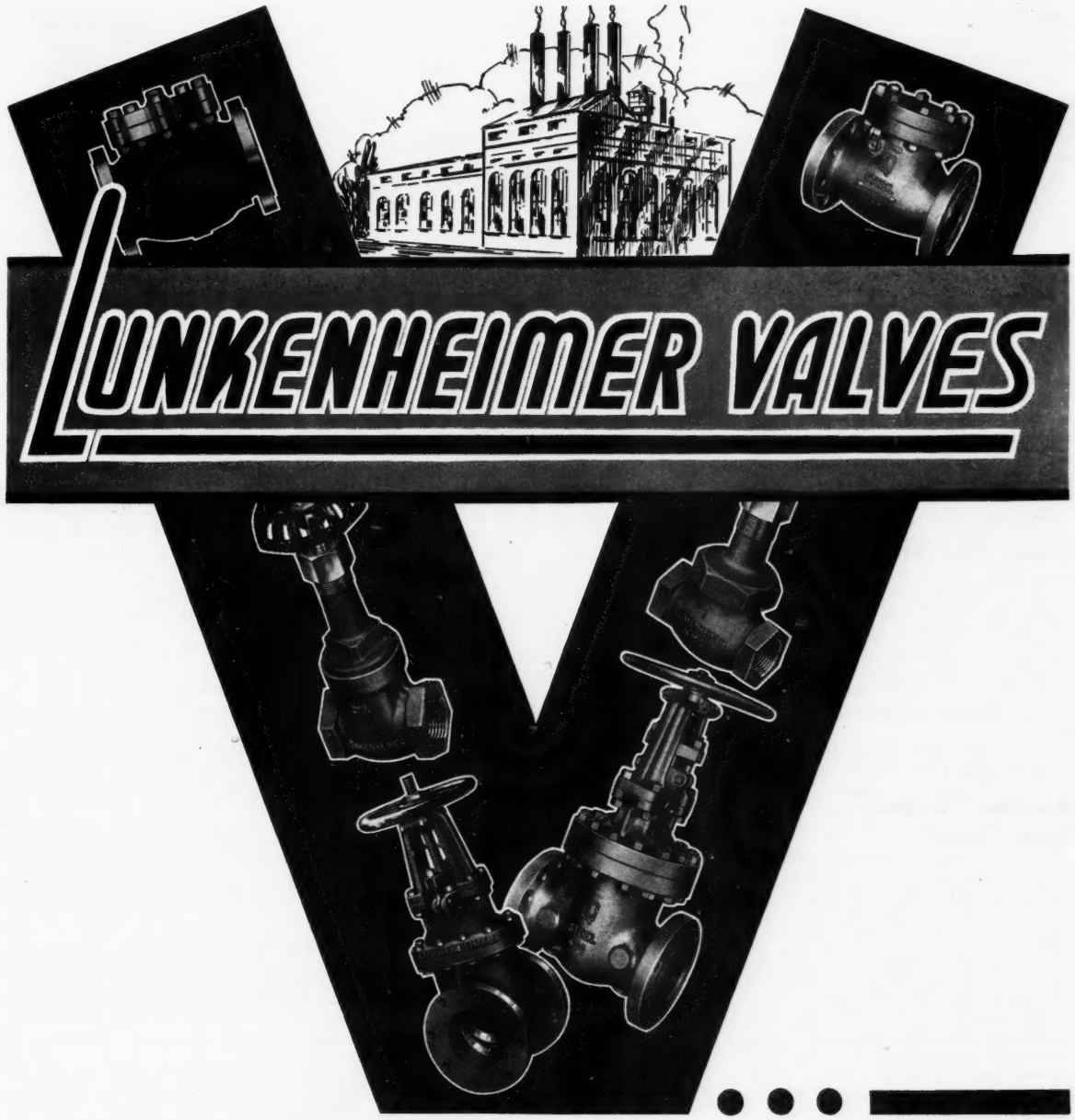
It is a matter to which every serious minded person should give more than cursory attention because the answer to this question is of importance to all of us. It will take co-operation on all our parts, but I feel that the engineer is destined to play a large and important part in re-establishing a world in which the human race can live in some degree of comfort and security. Engineers, as a rule, however, are most cautious in making suggestions and it is for this reason that I want to bring the matter to their attention here.

I listened to a discussion at a meeting recently in which it was finally decided that the problem was specifically an engineering one and that it was up to the engineers to do the job. So if we have to "daddy" the job, it will be well for us to prepare ourselves for it in advance.

One of the big problems will be to find work for the millions now engaged in defense production and in actual combat. There is, of course, no simple solution, but I feel that we should give attention to classes of projects which can be made self-supporting such as the new Pennsylvania Turnpike, which already has proved a splendid investment.

I drove over this great highway from Harrisburgh to Bedford recently in about one-third of the time required to go over the old route and saved considerably more in gas than the cost of the toll. Of course, only people who are in a hurry will use the Turnpike. Those interested in scenery will continue to use the old roads but these also should be widened and put into first class shape. The Turnpike should be extended in all directions across the country. This alone would provide employment for large numbers of people. Another vast self-supporting industry which undoubtedly will figure in the "reconstruction" is the aircraft industry. I was greatly impressed by the great airport the government is constructing along the Potomac at Washington and again was surprised when I saw another great airport in process of construction at Johnstown, Pa., near the summit of the Alleghenies.

Judging from what I see and read of other vast air fields, I can visualize, in peace time, a much greater commercial air travel system than anything we have dreamed of before. People who are in a hurry will not want to be landed 10 mi. from the center of cities. This will require the use of systems involving small shunt planes and city landing fields. It may change the character of our cities, doing away with skyscrapers and the construction of landing fields on the roofs of smaller



are important in

NATIONAL DEFENSE

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI, OHIO. U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

buildings. This would all require a tremendous amount of work and provide employment for many people.

The reclamation of waste products offers tremendous opportunities for saving and for giving employment. Not long ago I examined a city dump where I found empty tin cans in a pile 100 ft. wide and deep and not less than 1,000 ft. long. I was told that there were two other similar large dumps near the city.

Furthermore, there are thousands of acres of fine vacant farm land close to cities, just begging for some good families to move out and care for them.

Sometimes I think we may not need to plan for the future because it seems that we may be drawing toward the end of our present civilization, but as engineers we have no alternative. We must plan and try to arrange things regardless of what the actual future may hold.

H. SUMNER BRACKEN
Pittsburgh, Pa.

Thank You, Kind Lady

DEAR SIR:

After reading your article on Photometric Visualizers I decided to write and let you know that at least one woman looks through POWER PLANT ENGINEERING each month.

I especially enjoy each part of George Holman's "Refrigerating Engineer."

MRS. C. R. JACKSON
Fernandina, Fla.

Another "Squeak" From Parker

IT WAS told of William Jennings Bryan that he, at one time, maintained the right to tax a goat, "because it was property running and a butting on the public highway". The foregoing may have little relevancy, but it comes to my mind as I am preparing to rebut the rebuttal of one who still "ain't".

My usually sunny disposition has been in an eclipse and my spirits lower than an R.N.'s opinion of a Practical Nurse, ever since last August. My true confession, a definite contribution to Engineering *belles lettres,* dropped into a deep, dark tarn of chilly lack of interest and sank without a ripple. No splash—not even a "ker plunkah". But today I am myself again. I didn't cuss when some guy, figuring no doubt with his slip stick, angles of approach and incidence, was a little weak on accidents and ran his car into a column on our front portico. Nor did I grouch when, after a long period of hard, dirty work, I found a gob of mop rags in the sink drain. It seems there *was* a "squeak"—Parker's squeak.

Mr. "Ain't", thank you for the evident sincerity of your respect for my few grey hairs and the aridity of the area where hairs are not[1]. A large part of that area was denuded by the periodical "goings over" I give the nurses and nurses aides' (lemon aides, I calls 'em) when they're late for the bus, when they leave their windows open and holler for heat; when they drop safety razors and false teeth in the drains, or any other of dozens of fool things R.N.'s do just 'cause it's the nature of the animal. And furthermore, I don't repair nurses' hearts—I, er, *break* 'em.

[1]Ed. Note: "Glabrous" is a good word here.

Peterborough Hospital in Winter

My two lawn mowers are taken apart periodically and thoroughly greased. There is not one single piece of apparatus under my jurisdiction whose condition, date of last inspection, idiosyncrasies, and recommendations for improvement and repair doesn't appear in my record books. For instance, quoting from my records, my routine inspection of our ultra modern "Aga" range of Oct. 15, '41, showed a draft of .05 in., which was more than twice too much and I opened a slide in the pipe 2-7/16 in., which reduced the draft to .02 in., the correct amount specified by the makers for perfect combustion. Nov. 2, '41, my inspection of our electric elevator confirmed, still more, my conclusion that the right hand cable is wearing the sheave much more than the other two cables. I have already lost one sheave for the same reason. Do you know why? Probably not. You can no doubt draw a picture of it from foundation block to upper hatchway limit stop and from the bats in the garret to the silver which one of the lemon aides dropped into the pit.

I tried to refute none of your arguments. I agree with you that I am not an engineer and I take a very great pride in appearing in print with the mighty I have admired for years from my lowly position. With those who definitely *are* engineers, and even with those who *"ain't"*.

I simply tried to express, feebly no doubt, my impatience with a defeatist attitude and a firm conviction that a man's rewards are in proportion to his effort, no matter what his line of endeavor.

ARTHUR H. PARKER.
Peterborough, N. H.

More Power To Bill Maddock

BILL MADDOCK is to be congratulated. Every job should be a stepping stone to a better one. Every engineer should not only try to improve himself, but also the plant in which he works. Many engineers are willing to remain stationary (both in positions and ideas) after they find themselves in a little better than the ordinary position.

I like this idea of having the men rotate jobs so that every man knows the plant from top to bottom. It is a pleasure to be able to leave a job and know that the men with whom you have worked will be able to move up into the better positions, also this method of operating in a plant should make it possible for a man to return if there is a better position open for which he is qualified.

Bill was lucky to get into a civil service plant that was not loaded with political appointees that the only thing they knew was how to get a few votes.

I believe the real reason for Bill leaving is that he feels that he is at the top so far as that plant is concerned. No doubt there are many things that can be worked out to improve plant operation or cut operating cost. If the plant can't be improved, perhaps the town can be. Why shouldn't the engineers take a part in the affairs of the community instead of letting the lawyers and politicians run everything to suit themselves?

As for the plant being ahead of its time, I do not believe any plant is ahead of its time unless the individual units are so large that they will not operate economically on the load they have to carry.

If a plant can produce current cheaper than other plants, why should it shut down?

The cost of interest on the investment is the same whether the plant runs or not. Depreciation is almost as much when a plant is idle as when it is running, in some cases it is more when the plant is idle.

If the civil service plants throughout the country were as free from politics as the Glendale plant appears to be, civil service jobs would be at a premium and a man would have to know his stuff to even get on the list.

Congratulations to the superintendent and the civil service commission of Glendale for the job they have done. When a man can leave their employment after 1 yr. and tell the world that there are no politics connected with the job, they certainly have done a wonderful job.

HAROLD D. BROWN.
Lombard, Illinois.

For every industrial service there is a JOHNS-MANVILLE INSULATION specially designed to provide highest operating efficiency, long life and maximum fuel savings - - -

Here are brief facts on a few of the most widely used J-M Insulations. For full details, and for information on J-M Insulation Engineering Service, write Johns-Manville, 22 E. 40th St., New York, N.Y.

• • •

FOR STEAM LINES UP TO 600° F.—J-M 85% Magnesia Pipe Insulation. For many years this material has been proving its ability to maintain its high insulating efficiency in service. It is the most widely used power-plant insulation.

FOR STEAM LINES UP TO 700° F.—J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, salvage value and resistance to vibration and abuse are essential.

FOR HIGH-PRESSURE SUPERHEATED STEAM LINES—J-M Superex Combination Insulation, consisting of an inner layer of Superex high-temperature insulation and an outer layer of J-M 85% Magnesia or Asbesto-Sponge Felted. Combines unusual heat resistance and high insulating efficiency.

FOR BOILER DRUMS, WATER WALLS, FEED-WATER HEATERS, TANKS, BREECHINGS AND UP-TAKES—J-M 85% Magnesia Blocks for temperatures up to 600° F. Strong, durable, lastingly efficient.

FOR COLD-WATER LINES—J-M Anti-Sweat Pipe Insulation—a cold-water pipe insulation designed to prevent condensation and damage from dripping.

FOR REFRIGERATED SERVICE—J-M Rock Cork Sheets and Pipe Insulation—basically mineral, Rock Cork cannot rot and will not harbor vermin or support mold. It is highly moisture-resistant and retains its unusually high insulating efficiency indefinitely. Widely used for refrigerated equipment and piping, air-conditioning ducts and cold-storage rooms.

FOR FURNACE INSULATION—J-M Superex Blocks, for years the most widely used block insulation for temperatures up to 1900° F. Combines high heat resistance with low thermal conductivity.

J-M Insulating Brick (3 types) and J-M Insulating Fire Brick (4 types) for temperatures up to 2600° F. Furnished in all standard 9" shapes of the 2½" and 3" series, as well as in special shapes.

Also J-M Sil-O-Cel C-3 Concrete, cast on the job from Sil-O-Cel C-3 aggregate and cement. Sets up into a strong, durable semi-refractory insulating concrete for temperatures up to 1800° F.

SHOP TALK

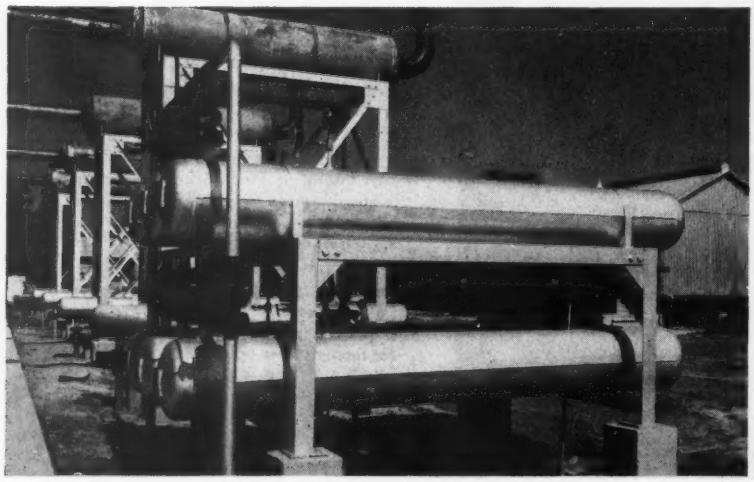
A department showing by means of photographs how engineers in various plants have overcome certain obstacles or devised methods to facilitate operation. If you have done something along similar lines that you are proud of or which you feel may be of interest to others, send us a picture and a paragraph of explanation. If the photograph is good and if the idea is original we will present it on this page and pay you for it.

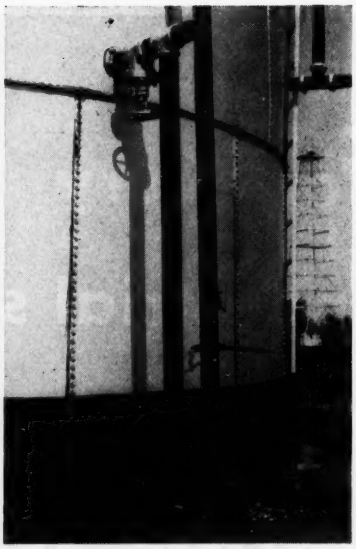
GROUP DRIVE. At the left is shown a good view of a modern group drive. It is the installation at the International Braid Co. plant utilizing dynamically balanced pulleys and Fafnir Ball Bearing Hanger Boxes. These shafts run at 1200 r.p.m. By means of this and similar other drives in this plant, the motor loads dropped from 72 to 48-hp., a saving in power of 30 per cent on each group.

RESERVE FUEL SUPPLY. Where gas engine driven generators furnish power and light for a plant, and where the fuel is drawn from a high-pressure main, some sort of storage as shown in the photograph below is advisable to guard against shutdown in case of damage to or temporary stoppage of the fuel supply. By mounting a series of steel storage tanks in the fuel system, each tank being 16 in. by 12 ft. and designed for 350-lb. working pressure, one plant provides sufficient fuel storage to run one of the gas engine units over a considerable period of time, assuring light for any plant repairs which may be under way or contemplated.

The storage cylinders are floated on the gas line, but each or all may be cut off to retain their charges of gas under pressure. A drip on each cylinder permits pressure-draining of any condensates collecting there during normal operation of the system.

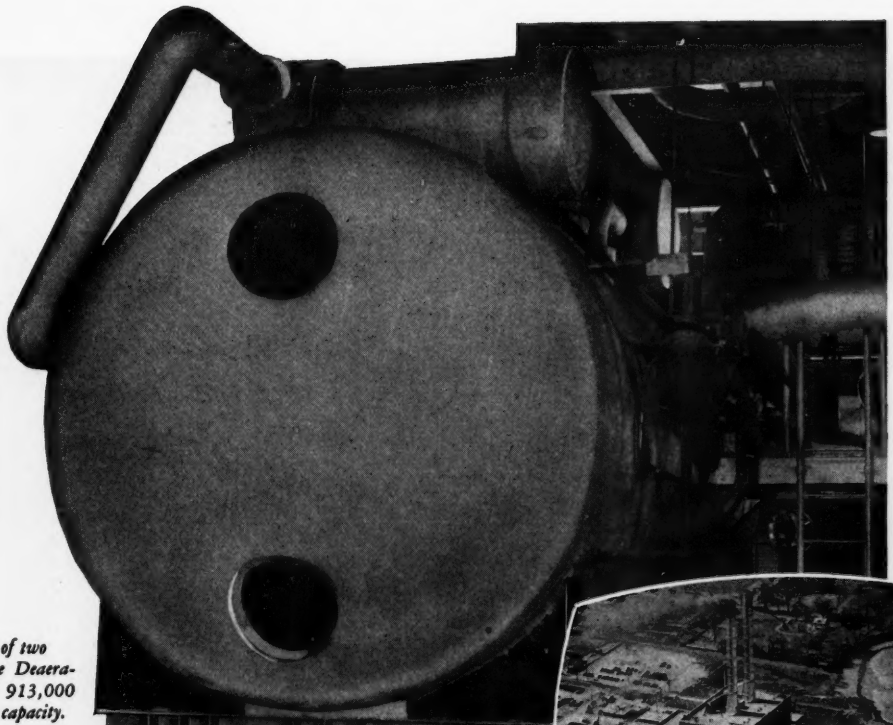
Since the storage bank is located ahead of the regulators stepping the pressures to those required for engine operation, full line pressure may be maintained in charging the tanks, and the bank cut off ahead of the shutdown or temporary fuel stoppage. Installation of a check in the gas flow line prevents accidental drainage of the tanks in case of a feed line breakage.





HANDY STEP. Locating a control valve close to the tank to reduce the number of possible leakage points to a minimum, the valve was found to be too high for easy manipulation. Rather than build a portable stand—always somewhere else at the times it is needed on the job—a step was formed which carried at its end a clamp which, when bolted together, fitted loosely around the vertical pipe of the line in which the valve was located. Set-screws through the clamping member permit this adjustable step to be clamped to the pipe at any desired height, affording a safe standing for the operator as he manipulates the valve. Where tank clearage is slight, or to prevent unauthorized tampering with the valve, the set-screws may be backed off and the step raised or swung against the tank plates to render it inoperative.

PROTECTIVE GRILLE. Location of the steam turbine driven generator adjacent to the door into the auxiliary room in a portable compressing plant presented a hazard through the locating of hot equipment close to the doorway. A grille, made up of a square section of built-up steel flooring, was mounted in front of the turbine, the open spaces in the grille permitting inspection of the unit, allowing ample air for ventilation of the steam end, and requiring but a minimum of floor space.



One of two Cochrane Deaerators of 913,000 lb./hr. capacity.

(Below) Air view of Oswego Steam Station of Central New York Power Corp.

OSWEGO UNITS NOS. 1 AND 2

CENTRAL NEW YORK POWER CORP.

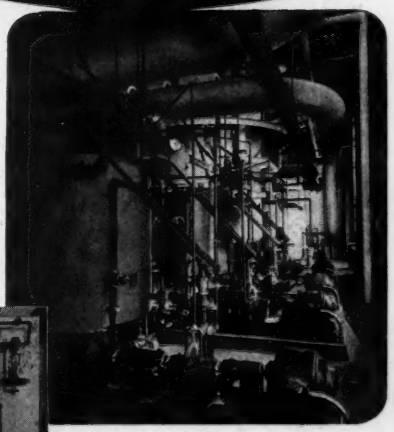
rely on Cochrane Softening & Deaeration

THE Oswego Steam Station of the Central New York Power Corporation has had one of its 80,000 kw. units installed for over a year, and the second was recently placed in operation.

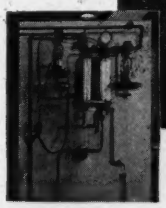
Both these units use Cochrane Feedwater Conditioning Equipment. Cochrane Deaerating Hot Process Softeners prepare make-up for the evaporators and are designed for lime and soda with supplementary phosphate, or for two-stage softening.

Feedwater heating is accomplished in six stages. The first three are direct contact heaters and the last three are closed heaters. The Cochrane Deaerators, as illustrated above, are used as the third stage of direct contact heating and deliver 913,000 lb. per hour with zero oxygen content. Steam from the ninth stage bleed point on the turbine is used in the deaerator.

A new publication on Cochrane Deaerators is just off the press. A copy will be sent on request.



Proportioning Pumps, Chemical Tanks, Filters and Sedimentation Tank of Cochrane Deaerating Hot Process Softener.

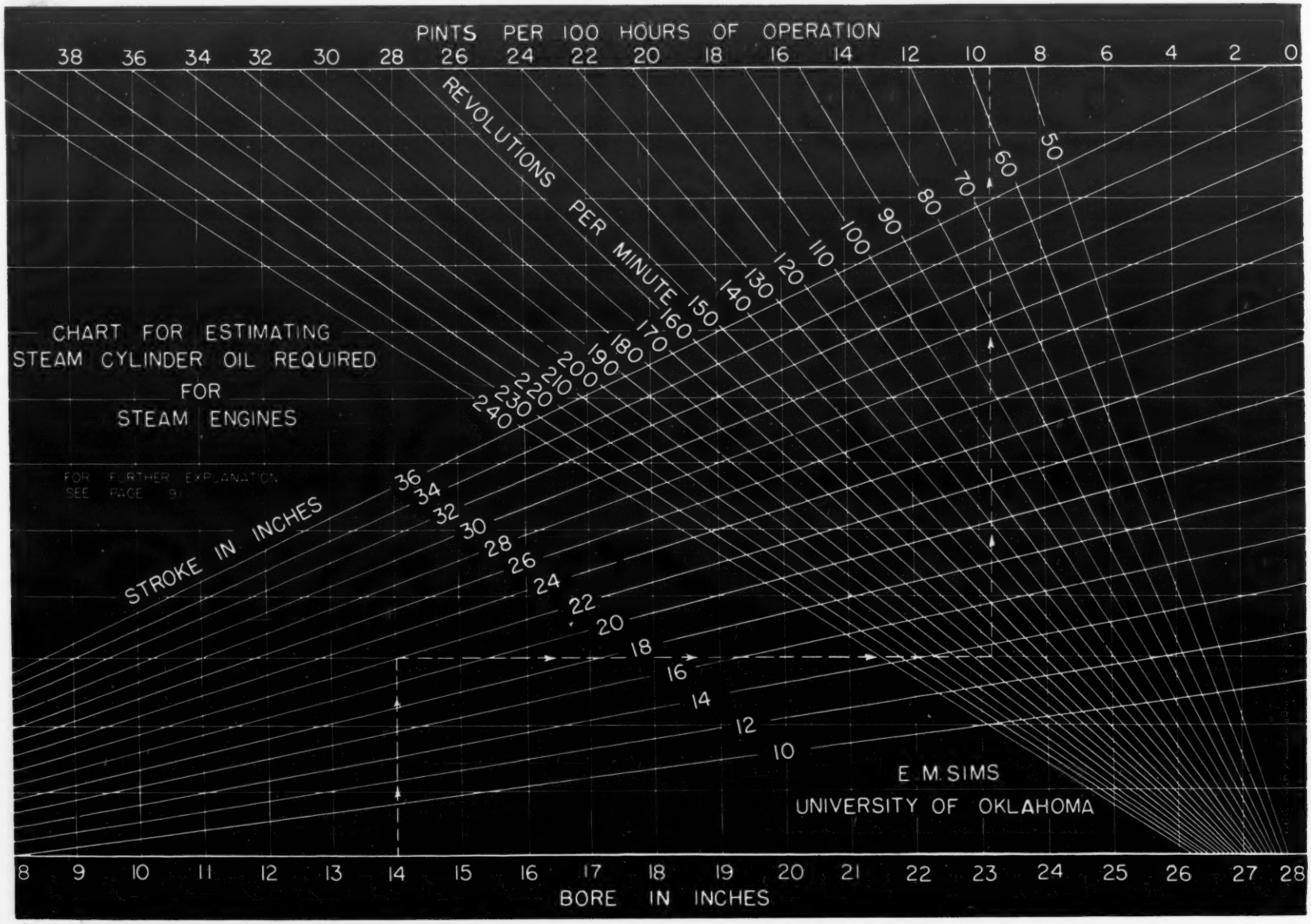


(Left) Cochrane Steam Sample Degasifier separates hydrogen from boiler outlet steam, for measuring dissociation of steam into hydrogen and oxygen.

Cochrane Corporation

3123 N. 17th ST. PHILADELPHIA, PA.

WATER SOFTENERS • DEAERATING HEATERS • DEAERATORS • BLOW-OFF EQUIPMENT • VALVES • FLOW METERS

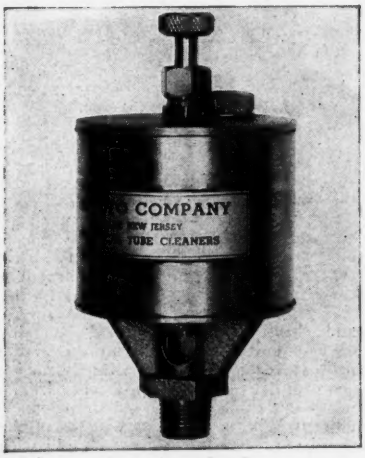

PINTS PER 100 HOURS OF OPERATION
38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
REVOLUTIONS PER MINUTE
50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240
CHART FOR ESTIMATING
STEAM CYLINDER OIL REQUIRED
FOR
STEAM ENGINES
FOR FURTHER EXPLANATION
SEE PAGE 91
STROKE IN INCHES
36 34 32 30 28 26 24 22 20 18 16 14 12 10
E. M. SIMS
UNIVERSITY OF OKLAHOMA
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
BORE IN INCHES

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Sight-Feed Lubricator

THIS NEW air-driven equipment which operates successfully regardless of its position in the line has just been recently developed by the Roto Co., Newark, N. J. Because it has no baffle, it can be turned to any position convenient for visibility. The sight-feed lubricator requires only a single regulating valve. Oil is added by removing a screw plug at the top of the lubricator. These lubricators are installed in an ordinary tee in the air line. They are made in 4/5 pint and quart sizes, and can be regulated to deliver as few as 5 drops of oil per minute. While the new lubricator was developed to assure a positive oil feed for the company's tube cleaners, it may also be used with other types of air-driven equipment.



Emergency Light Units

MEETING the increased need created by national defense activities for emergency light and power protection, The Electric Storage Battery Co., Philadelphia, Pa., announces four new Exide Emergency Light and Power Units for industrial use.

Split-second operation of the Exide Unit and absolute dependability—the two basic requirements for an emergency light and power system—are stressed by the manufacturer. These two features of the unit are made possible by the design of the unit, particularly of the transfer switch and the long-wearing quality of the material used in construction.

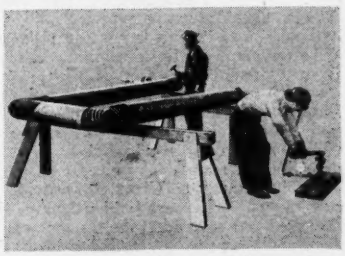
Each unit is used in connection with an Exide battery of either the Chloride or the Flat Plate type. The units have an automatic transfer switch which instantaneously transfers the battery to the emergency lighting circuit upon failure of the normal a.c. supply. When the a.c. service is restored, the emergency lighting circuits are instantly transferred back to the a.c. supply.

The battery is kept fully charged at all times, because immediately after normal power is restored, the battery is automatically placed on high rate charge. As soon as the recharging is completed, the high rate is automatically cut off and a copper oxide rectifier then supplies a trickle, or low rate of charge, just sufficient to maintain the battery in a fully charged condition, ready for the next emergency.

The new units, which are available in capacities of from 3400 to 10,000 watts, are particularly adapted to industrial plants engaged in defense work where interruption of the normal source of power may result in untold harm or damage. Other systems are available in capacities ranging from 240 to 100,000 watts, including those for safeguarding the continuity of highly important manufacturing processes during interruptions in the normal a.c. supply.

Pipe Bend Tests

IN TESTING its U type of expansion loop units, hydrostatic test to minimum of 300 p.s.i. is applied by Ric-Wil Co., Cleveland, Ohio, the pipe being heavily hammered at one end to set up oscillations throughout the loop so as to show up any weakness. Welded portions of the pipe are left exposed during the test, then Armco Hel-Cor is welded in at the corners, and the bends insulated with hot asphalt, asbestos felt and Kraft paper to match the rest of the pipe.



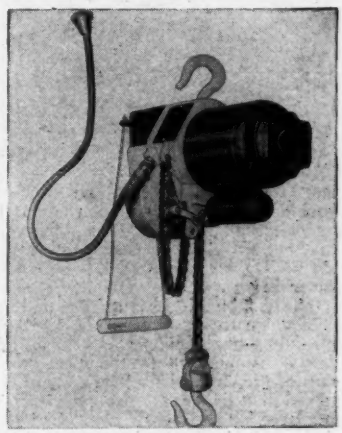
Reversible Motors

FOR USE on cranes, hoists, lathes and many other industrial applications where instantaneous reversing is necessary, a new capacitor-start reversing motor is announced by Westinghouse Electric & Mfg. Co.

Available in ratings of from 1/6 to 3/4-hp., single phase 60 cycle, the motor operates at 1725 r.p.m. on 115 and 230 v. circuits. To reduce maintenance, no brushes or commutators are used.

Reversing the motor requires a special centrifugal-starting switch with two contacts, a solenoid relay, and a resistor, all of which are furnished as a part of the motor. A drum switch must be provided separately to operate the motor.

In operating, the drum switch is closed, setting up a power circuit through the solenoid relay and the motor windings. The relay transfers the circuit from the lower to the upper contact and locks the relay across the line. Line voltage across the motor main and starting windings starts the motor. The centrifugal-starting switch opens at a predetermined speed to disconnect the starting windings and the motor operates on the main winding as an ordinary single-phase induction motor.



To reverse the motor it is simply necessary to throw the drum switch to the other side, and a similar sequence of operations takes place.

Greater torque during the starting and accelerating period is obtained since the capacitor is placed immediately on the auxiliary winding circuit. The circuit also protects starting winding from damage and possible motor burnout.

Babbitt Metal

NEW babbitt metal for bearings subject to high pressures and temperatures, known as Power Nickel Genuine Babbitt, has been developed by Magnolia Metal Co., Elizabeth, N. J. It has a tensile strength of 17,500 lb. and yield point of 6500 lb. per sq. in., a Brinnell hardness of 27, and its pouring temperature ranges from 950 to 1000 deg. F. The high softening and melting temperatures make the metal resistant to extreme local heat, while unusual strength adapts it to heavy bearing loads. Nickel treatment gives the metal a hard glossy surface, desirable for generators, motors and other high speed applications.

High-Power Floodlighting Concentrator

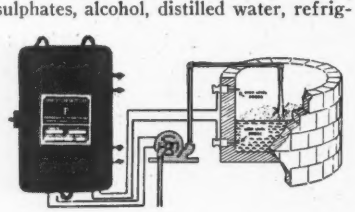
A NEW-TYPE concentrating floodlite bulb designed for high bay lighting in industrial plants, auditoriums and stores with high ceilings especially, has recently been developed in the Birdseye Division of Wabash Appliance Corp., Brooklyn, N. Y. The new Birdseye bulb is said to deliver a concentrated flood of light that

cuts through distance, haze and smoke to provide brilliant illumination even in foundries and factories where high ceilings and traveling cranes or other obstructions make impractical the installation of lights closer to the work plane.

The new bulb is designed especially to force down to the work plane level the full light that the filament develops. The filament is mounted at the exact focal point of the hump-shaped parabola of the bulb, so that light rays are forced straight out of the bulb without waste. The inside of the bulb is lined with pure polished silver to form a permanently brilliant reflector that cannot be dimmed by dirt, fumes, or smoke. The 1500 watt industrial size is illustrated. Twelve smaller sizes are available.

Electronic Level Control

PHOTOSWITCH Level Control Series P16 made by Photoswitch, Inc., Cambridge, Mass., provides on and off valve or pump control of any liquid. It is used for the control of water, milk, nitrates, sulphates, alcohol, distilled water, refrig-



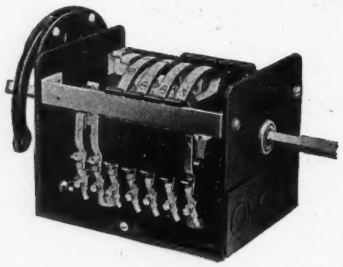
erants, gasoline, etc. Complete equipment is available for single level indication and control, on and off pump-up and pump-down control at two levels, boiler feedwater control and low level safeguards. Probe fittings have been designed for high and low pressure and temperature requirements as well as for sanitary installations.

Probes or electrodes are attached to the tank at levels representing the low point where pumping starts and the high level where pumping stops. These probes are wired to Photoswitch Level Control. When the liquid level falls below the lower probe, the Level Control starts the pump in operation and the tank fills. When the level rises to the upper probe, the fluid itself acts as a conductor of the small amount of current required for the operation of Level Control which stops the pump. Even when used with non-conductive fluids, the probe circuit carries only milliamperes of current and low voltage.

Drum Controllers

NEW LINE of drum controllers for small cranes and hoists is announced by Cutler-Hammer, Inc., Milwaukee, Wisc., which are compact and have several features of outstanding interest.

Rope operating lever, embodying a new equalized torque principle, eliminates sheave wheel, rope guard and external return spring, and provides smooth, easy



operation even when the rope is pulled at an angle. Anti-Plug feature increases drum life by making it impossible to whip drum from full forward to full reverse position. Drum can be reversed quickly, yet a definite time delay is required in the off position.

These drums are available in self-centering rope lever, self-centering and non-self-centering radial lever types, for four or six speeds.

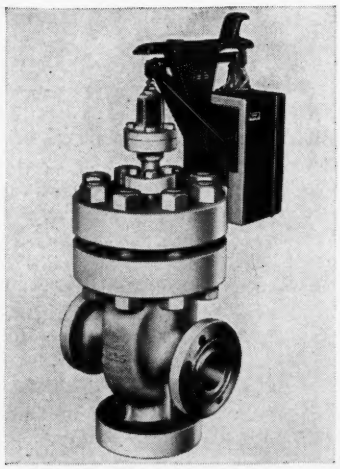
Fluorescent Luminaire

TO SPEED UP production in industrial plants, where extended light lines are desirable, a new 40-w. fluorescent luminaire is announced by the Westinghouse Elec. & Mfg. Co. Known as type FPS-40, the luminaire uses 2 or 3 lamps per reflector and will provide lighting intensities of from 30 to 100 footcandles with maximum diffusion, minimum glare and uniform distribution at ordinary spacing and mounting heights. It provides adequate visibility for close work such as reading precision micrometers, veniers, and other shop instruments. Channels provide a continuous wireway which may be mounted on conduit, messenger cable, twin-rod suspension or directly on the ceiling. All auxiliary equipment is mounted in the channel. The units have twin-ballasts with built-in compensators providing power factor of 90 per cent or over.

Power Control Valve

ASHCROFT Power Control Valve for high-pressure installation from 1800 to 2500 lb. is announced by the Consolidated Safety Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. This is an automatic relief valve that may be set for a 1 per cent or less difference between opening and closing pressure. The immediate results are more accurately balanced boiler operation at peak loads and more uniform line pressure. In addition, its use reduces safety valve maintenance expense.

The valve is set to open at a slightly lower pressure than any of the safety valves, making it possible to continue a more even rate of steaming with a more uniform line pressure.

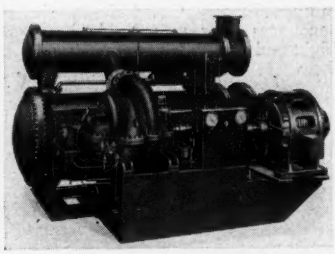


Principle of operation of the valve is that the boiler drum or superheater outlet pressure, or steam header pressure actuates a pressure control set at the popping pressure, which operates an electric contact on a difference in pressure of 1 per cent or less, the electric current being transmitted to a solenoid which opens and closes the pilot valve. When this opens it unbalances the pressure over the main valve disc which opens and remains open until the pilot valve is closed. The whole cycle of operation is almost instantaneous. The valve opens exactly at the popping pressure and closes cleanly with an extremely low blow-down. High superheat temperatures have no effect on its action. It may be operated manually from the control station.

This valve is not intended to replace the spring-loaded safety valve, but is a supplementary operating valve, designed to conserve power and increase the efficiency of the steam generating plant.

Liquid Cooling System

FOR AIR CONDITIONING and industrial processes, Worthington Pump and Machinery Corp., Harrison, N. J., has developed a new line of liquid cooling systems, with volute centrifugal compressor



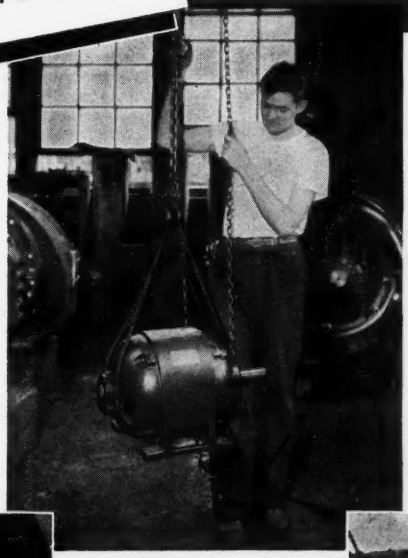
which has dual lubrication, balanced end and side thrust accomplished by the arrangement of impellers and volutes. Systems are available from 150 t. to 1200 t. refrigeration and have been used in air conditioning of controlled temperature plants for precision manufacture of aircraft and aircraft engines.

SEE HOW YOU SAVE TIME

WITH THE TRI-CLAD MOTOR

REG. U. S. PAT. OFF.

Extra Convenience Features help you get the Tri-Clad motor into service faster—keep it in service with less attention.

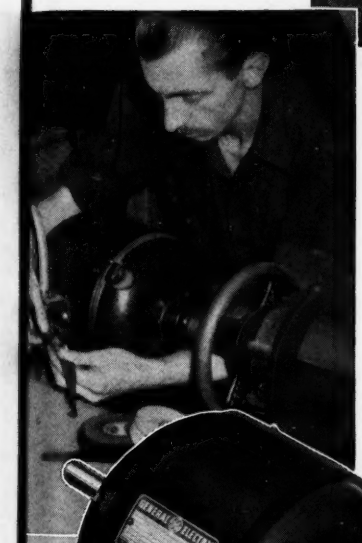


1. Easy to Handle

They can be moved into position easily because of their light weight and compactness. The shape of the bearing housings and the location of end-shield fittings make it easy to handle Tri-Clad motors with slings. In addition, they are sturdily built and do not have to be coddled.

2. Quickly Mounted or Altered

Their feet are machined accurately and drilled for standard mounting bolts. The reversible stator puts the roomy conduit box on the most convenient side and the end-shields can be rotated to any of four positions to meet mounting requirements.



3. Easy to Wire

A large, four-position conduit box gives unrestricted working space. It can be quickly removed for wiring. Flexible leads are pressed on the terminals which are permanently identified. No soldered connections are necessary. A stainless-steel, graphic connection plate is conveniently located on the conduit-box side of the motor.

4. Convenient to Lubricate

All Tri-Clad motors have a large oil or grease capacity. On sleeve-bearing motors, the oil-filler gage can be located on either side of the bearing housing. A spring cover on this gage permits quick checking of the oil level. On ball-bearing motors, a pressure-relief greasing system assures rapid and thorough greasing.

BUILT FOR PROTECTION FIRST . . . TO LAST

The new General Electric Tri-Clad motor is a cinch to install. Its convenience features pay off in precious minutes saved—both for those who build motors into machines and for those who use them in a plant.

Next time you order motors, take *time-saving* into account, along with protection and performance; make sure you get Tri-Clad motors—now available in a wide range of types and integral horsepower sizes to 20 hp.

Write for Bulletin GEA-3580 which gives full details about these extra protection features and other Tri-Clad motor advantages.

Extra Protection 3 Ways

HELPS ASSURE LONG SERVICE LIFE

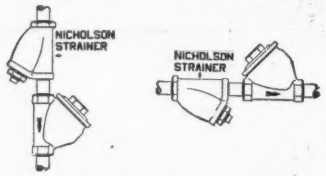
Production interruptions are avoided and operating time is saved when the motor you buy can stand up under the many adverse operating conditions commonly found in industry. Tri-Clad motors meet these conditions with—

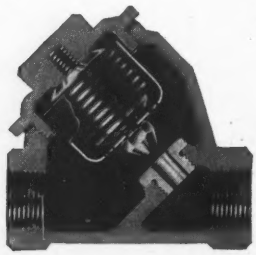
1. *Extra Protection* against physical damage
2. *Extra Protection* against electrical breakdown
3. *Extra Protection* against operating wear

GENERAL ELECTRIC

Industrial Steam Trap

OF THERMOSTATIC bellows type, a new industrial steam trap manufactured by W. H. Nicholson & Co., Wilkes Barre, Pa., gives intermittent discharge with no adjustment, can be mounted horizontally

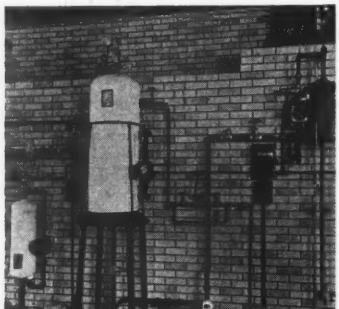




or vertically, has stainless steel valves and seats and phosphor bronze bellows. It comes in ½ and ¾-in. sizes. The hourly capacity for the former is 495 lb. per hr. at 0 p.s.i. to 9610 lb. per hr. at 200 p.s.i. For the latter the range is from 570 to 11,060 lb. per hr.

Condensate Return

THIS SINGLE and dual line of condensate return and boiler feeding systems announced recently by W. M. Acker, Inc., Cleveland, Ohio, is adaptable to plants operating up to 250 lb.; the single system automatically returns condensate,



and supplies make-up water to boilers when actuated by mercoid switch at the water column. Make-up water is admitted to the receiver tank by float-operated valve when condensate reaches a predetermined low level or is insufficient to satisfy the needs of the boiler, handling either high or low-pressure condensate and make-up water.

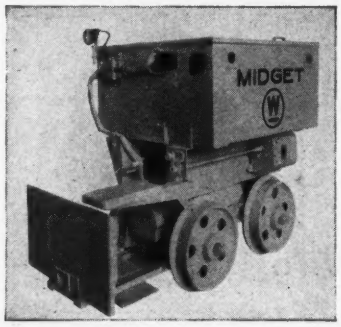
Variable Speed Control

A NEW V-belt variable speed transmission known as the JFS-CUB has been recently introduced to industry by Standard Transmission Equipment Co., Los Angeles, Calif.

The JFS-CUB, the newest addition to the line of V-belt speed controls manufactured by the company, is especially designed for all A section V-belt applications and for speed ranges up to 3.3-1. Smooth sided pulleys are used rather than the interlocking type. Among the advantages claimed are: a patented positive belt alinement feature which makes possible the mounting of the CUB in any and every position without impairing function or throwing belts out of alinement; machined and balanced cast iron construction, forced lubrication of the special bronze bearings on which the pulleys rotate; free-end pulley spindle to permit easy installation of belts; both pulleys on one side of pivotal mechanism which permits motor pulley and driven pulley to be almost directly in line with each other; etc., are a few of the transmission's advantages. The CUB will transmit full capacity of A section V-belts, and can be used with all machines now using that size.

Mine Locomotives

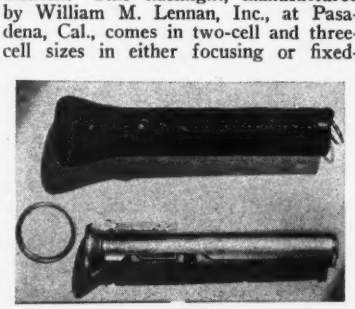
FOR USE in mines, a new storage battery tramming locomotive was recently announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This unit,



known as the Midget, weighs 1½ tons, is operated by a 5-hp., 40 v. d.c. traction motor with the power transmitted through a torsion ring coupling to worms driving worm gears. The rated drawbar pull is 400 lb. and the unit will negotiate a curve of 6 ft. radius.

Rubber Flashlight

RUB-R-LITE, the new patented rubber flashlight that can be dropped on asphalt pavement from six stories and still work or can be left in water three months without damage, enters the national market this month through jobber organizations. This flashlight, manufactured by William M. Lennan, Inc., at Pasadena, Cal., comes in two-cell and three-cell sizes in either focusing or fixed-



focus types. A special patented two-button snap switch is claimed to do away with the common switch problems, while the patented inside battery-case (with side opening) prevents corroded batteries from being permanently stuck. It has an aluminum plated reflector with a shatterproof, plastic lens, and throws a clean, powerful, long-range spot.

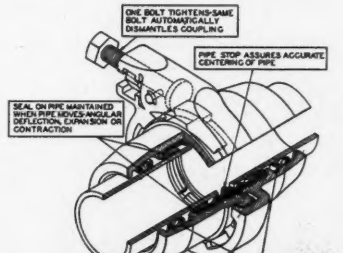
The light is completely insulated in its molded, air-tight, one-piece resilient rubber case. It is safe for working around electric wires and has withstood a 5000 v. breakdown test. It cannot be magnetized from tool boxes, engine rooms or ships where a surrounding of metals often magnetizes and wears out batteries whether used or not. In fact, it is especially designed to withstand exceptional abuse and hard wear. The waterproof, no-slip qualities allow it to be used in rain, mud or salt water, while any change in temperature has little or no effect on the light itself.

New Paints

FIVE new Valdura paints to replace now unavailable aluminum paints are announced by American Marietta Co., Chicago, Ill. They are for new construction or maintenance and may be applied by brushing or spraying. Tank White, designed to reduce evaporation losses and reduce inside temperatures, is resistant to oil and water. Metal Lead, to cover metal surfaces, gives a coating resistant to acids, alkalis, fumes, rust and moisture. Defense Grays, for low cost protection of metal surfaces give elasticity, are high gloss and resistant to rain, sun, smoke and rust. Enamelized Yellow Primer, for metal surfaces especially where wet, may be used under water when covered with Defense Grays.

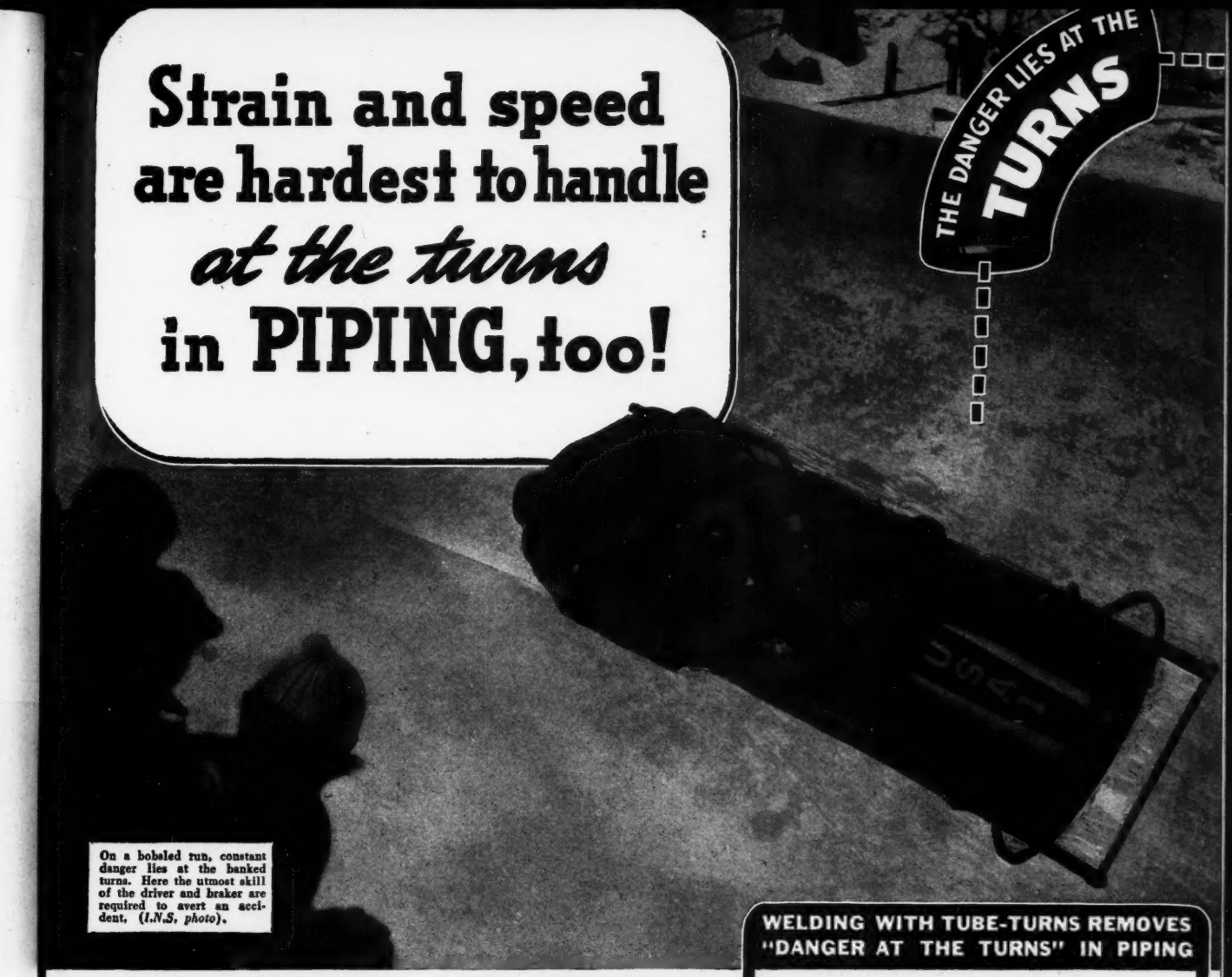
Ball Grip Pipe Couplings

A NEW type ball grip pipe coupling permitting flexibility at the joint and simplicity in making connection or disconnecting has recently been introduced by Hanlon-Waters, Inc., Tulsa, Okla. Among the outstanding features of these couplings is the ease of installation with resulting savings for either permanent or temporary pipe lines. Provision has also been made for expansion, contraction and angular deflection of 7 deg. each end of coupling.


ONE BOLT TIGHTENS-SAME BOLT AUTOMATICALLY DISMANTLES COUPLING
PIPE STOP ASSURES ACCURATE CENTERING OF PIPE
SEAL ON PIPE MAINTAINED WHEN PIPE MOVED-ANGULAR DEFLECTION, EXPANSION OR CONTRACTION
NO SPARKS OR DAMAGE FROM METALLIC BLOWS
BALL RETAINER FRICTIONALLY ENGAGES PIPE AUTOMATICALLY-BALLS FLARED IN LOCKED POSITION WHEN PIPE IS PULLED OUTWARD

H-W Ball Grip Couplings consist of a housing with ball retainer and a flexible sealing gasket. The ball retainer or cage carries a large number of balls and a frictionally engaging means, so that after the pipe is inserted and pulled outward the balls are brought into contact with the tapered surface causing a positive lock, preventing the pipe from being withdrawn. One bolt tightens the connection and the same bolt reversed automatically allows the coupling to be dismantled. All couplings are provided with a pipe stop to assure pipe being centered in coupling. The coupling further permits rotating of valves and fittings on pipe axis without disconnecting.

Strain and speed are hardest to handle *at the turns* in PIPING, too!



On a bobsled run, constant danger lies at the banked turns. Here the utmost skill of the driver and braker are required to avert an accident. (*I.N.S. photo*).

Insure safer, stronger, trouble-free piping systems with TUBE-TURN welding fittings

When the fluids or gases in your piping systems zoom through the lines and swerve into the turns—*added* strain and friction strike the fittings and joints. Trouble usually develops here *first* in any piping system *because the most danger lies at the turns!*

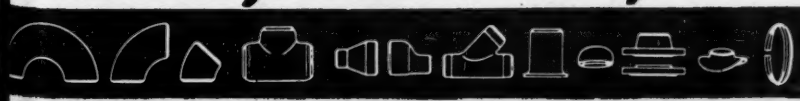
Weld with TUBE-TURN fittings and *your* plant piping systems will last far longer, function more efficiently and safely, save valuable space, and cut upkeep costs.

There is a TUBE-TURN for *every change in flow direction*—elbows, returns, tees, reducers, laterals, nipples and flanges—made with Tube-Turns' exclusive forging process to give unequalled reinforcement at these danger spots.

Get complete facts in the helpful Tube-Turn engineering data book and catalog. Write today!

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

TUBE-TURN
TRADE MARK
Welding The FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*

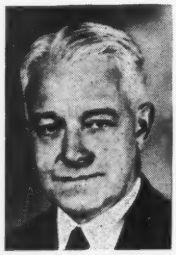


WELDING WITH TUBE-TURNS REMOVES "DANGER AT THE TURNS" IN PIPING

When you think of "turns" in piping systems, remember they occur within tees, reducers, laterals, nipples, heads, etc., as well as within elbows and returns. Wherever there are abrupt *changes in flow direction* you'll find *extra* wear and tear. TUBE-TURN welding fittings provide maximum *extra* strength and safety, and practically eliminate maintenance troubles, at these *danger spots.*

Manufacturers' News

Howard W. Leitch Retires



HOWARD W. LEITCH, former vice-president of Consolidated Edison Co. of New York, Inc., retired on Friday, October 31, after 46 yr. of service. He is the only man in the Consolidated Edison System who took an active part in the evolution of the electric business from the early small plants to today's organization. Starting as a brushman in 1895, Mr. Leitch soon became a regulator and in 1902 went as operator to the Waterside Station which had been placed in operation the previous year. To co-ordinate the operation of the a.c. generating station and the substations for direct current a system operation group of three men—Mr. Leitch, Walter Burnham and William King, all now retired—was set up.

By 1905 Mr. Leitch had been appointed chief system operator and 2 yr. later was made assistant electrical superintendent at Waterside, the post from which he was selected in 1913 by The United Electric Light and Power Co. to get the new Sherman Creek Station on the Harlem River under way. Seven years later Mr. Leitch had another like job when the new Hell Gate plant was being built under his supervision.

In 1935, when United and New York Edison companies were consolidated, Mr. Leitch became associate chief operating engineer, the Brooklyn Edison stations being included a year later when forming the present Consolidated Edison System. He was made vice president in charge of electrical operations in 1938, serving until he reached the retirement age in 1940. Since then he has been working as a consultant on special assignments.

Defense Supervisor

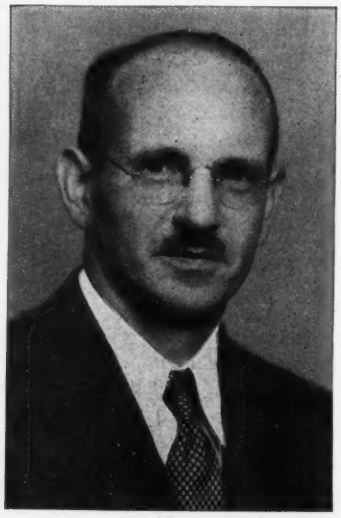
L. E. OSBORNE, former manager of manufacturing and engineering of the Westinghouse Merchandising Division, has been appointed assistant to the president in charge of the Company's national defense subcontracting program, George H. Bucher, President of the Westinghouse Elec. & Mfg. Co., announced. Mr. Osborne was granted a leave of absence by Westinghouse last January to join the staff of the Defense Commission in Washington. Prior to his new Westinghouse assignment, he served as chief of the heavy ordnance section in the production division of the Office of Production Management.

Westinghouse is "farming out" defense contracts at a rate of 6,600,000 manhours of work a year for employes of more than 300 small manufacturing companies. Mr. Osborne's position was created to expedite the letting of contracts and furnish a central point for the distribution of information to and from the interested governmental agencies.

Mr. Osborne joined Westinghouse in 1910 as a 16-yr. old tool clerk, was later trained to operate lathes and other tool room machines and becoming adept was assigned to train newly hired workers on tool work to boost production during the first World War. He was later appointed successively superintendent of the tool room, superintendent of the metal stamping department, assistant works manager of the Westinghouse plant at Newark, N. J., and then works manager.

E. C. Bolton, Branch Manager

APPOINTMENT of E. C. Bolton as manager of the Cincinnati District Sales Office is announced by Cutler-Hammer, Inc., pioneer electrical manufacturers. Mr. Bolton has been with the company since his graduation from Carnegie Institute of Technology in 1922. In 1925, after 3 yr. in the Engineering and Sales Departments, he took over Public Utility sales in the Chicago District. Shortly afterwards, his territory was expanded to include the entire Middle West and in 1935 to include the whole country.



General Electric Changes

SELECTION of five new vice presidents by the board of directors of the General Electric Co. has been announced by Charles E. Wilson, President. The new officers are: Walter R. G. Baker, Chester H. Lang, David C. Prince, Elmer D. Spicer, and Harry A. Winne.

Under the new setup, which involves a major change in the company's organization, there will be four major operating departments: Appliance and Merchandise, under Vice President Hardage L. Andrews; Radio and Television, under Vice President Baker; Lamp, under Vice President Joseph E. Kewley; and the Apparatus Department which, because of its great volume of business and diversification of products, will be staffed by five vice presidents, whose duties will be along functional lines; these vice presidents are: Mr. Lang, in charge of defense activities and also continuing as Manager of Apparatus Sales; Mr. Prince, in charge of application engineering, Earl O. Shreve, in charge of commercial activities, Mr. Spicer, in charge of manufacturing, and Mr. Winne, in charge of design engineering.

Mr. Baker, since 1917, has been engaged in development and testing of radio apparatus for aircraft, submarines, captive balloons, torpedo boats, destroyers, and battleships.

Mr. Prince, currently president of the American Institute of Electrical Engineers, joined General Electric in 1913. His contributions in the field of circuit breakers enabled the building of the super-speed breakers at Boulder Dam, the highest voltage and fastest breakers in the world.

Mr. Lang joined General Electric Co. in 1919, in 1922 was made assistant manager of the Publicity Department, served as comptroller of the budget from 1926 to 1932 when he became advertising manager and manager of radio broadcasting. He served for two years as president of the Advertising Federation of America and later as chairman of its board. In April, 1940, he was made apparatus sales manager and shortly afterwards was named chairman of General Electric's defense co-ordinating committee.

Mr. Spicer, chief engineer and factory manager of the Kerr Turbine Co. until 1924, served first on the staff of G.E.'s manufacturing general department. In 1941, he was named assistant to the vice president in charge of general manufacturing operations.

Mr. Winne, coming as a student engineer to the testing department, became head of the large motor, generator, and synchronous converter test in 1911. In 1937 he was named assistant to the vice president in charge of general engineering operations.

L. L. Biche

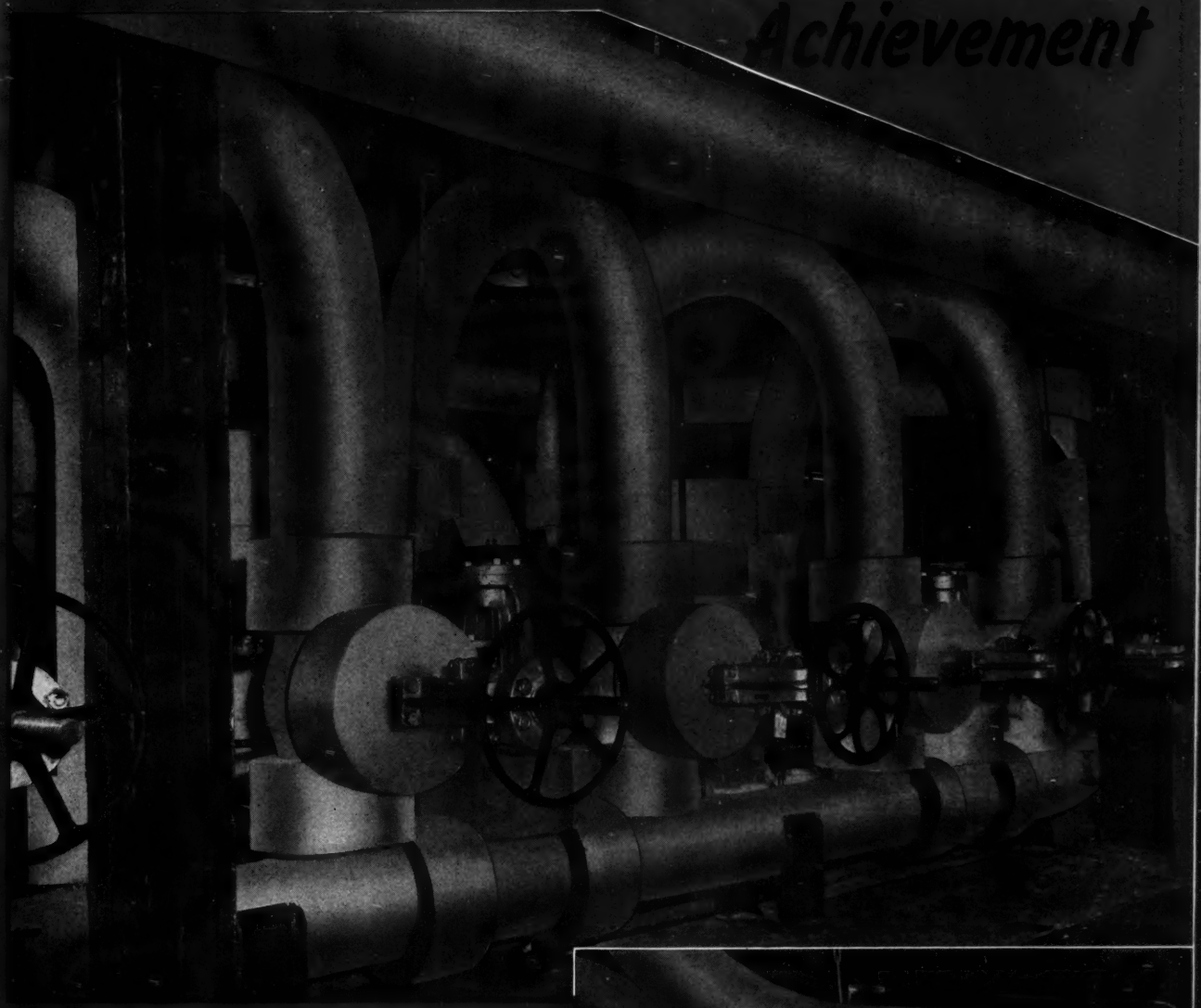
L. L. BICHE, manager of power transformer sales for the General Electric Co., died suddenly October 24 at his home in Pittsfield, Mass., at 53 years of age. Mr. Biche had been in apparent good health but was stricken with a heart attack.

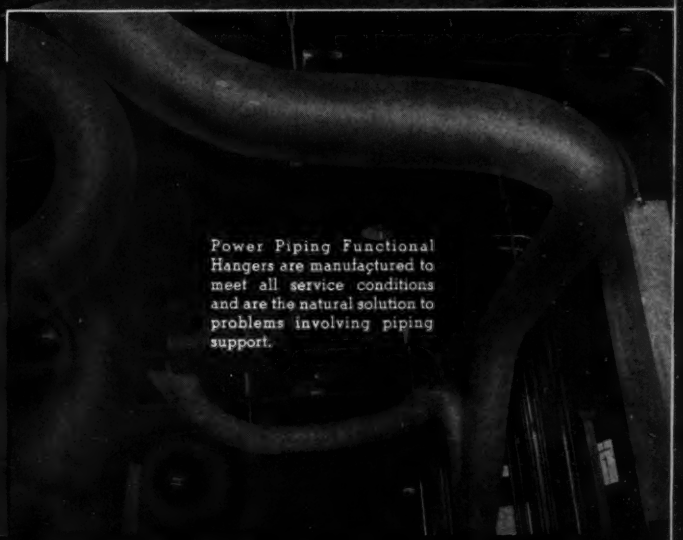
He graduated from Union College as an electrical engineer in June, 1912, then entered the employ of the General Electric Co. that same year and after a short period on Test in the Schenectady Works was transferred to the commercial engineering department of the Transformer Division at Pittsfield. In 1917 he entered the United States Army and served overseas in the Balloon Observation Corps, attaining the rank of a first lieutenant. He returned to Pittsfield in 1919, and in November, 1926, was named manager of power transformer sales, the position he held at the time of his death.

Hall Laboratories, Inc., announces the appointment of David Tobin, Hall Service Engineer, to the staff of Eshelman and Potter, Birmingham, Ala. Joining Hall Laboratories in January, 1941, with a chemical engineering degree from Michigan State College and varied experience in power plant chemistry and water conditioning problems, Mr. Tobin has undergone 10 mo. of laboratory and field training in Hall methods and will now have headquarters in Charlotte, N. C. He will share with L. Highley, Jr., Hall Service Engineer in Birmingham, the service requirements of the client plants of Eshelman and Potter in its southeastern United States territory.

Another

BLAW-KNOX POWER PIPING *Achievement*





Power Piping Functional Hangers are manufactured to meet all service conditions and are the natural solution to problems involving piping support.

The photographs show sections of a power piping system DESIGNED, FABRICATED AND ERECTED by Blaw-Knox Company — Power Piping Division. This includes 14" boiler leads forming an 18" x 14", concentric swage fitting and 10" feedwater assembly, prefabricated by exact methods to insure predetermined results. Power Piping Functional Hangers were used as the most expedient method for supporting the lines.

Regardless of size of job or pressure-temperature conditions specify POWER PIPING DIVISION service.

A copy of FLEX-ANAL CHARTS will be sent to any engineer asking for it on his letterhead. Ask also for bulletin entitled POWER PIPING FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS.

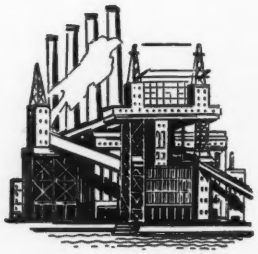
BLAW-KNOX COMPANY

POWER PIPING DIVISION

1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

★ THERE'S A BELMONT PACKING FOR EVERY SERVICE ★

For
STEAM



The defense program demands uninterrupted service of power plant equipment. Engines and pumps *must* be kept operating at maximum capacity, sometimes twenty-four hours a day—no time for frequent packing replacements.

Here are offered two standard Belmont Packings that *will* withstand the strain—Belmont 30 for reciprocating steam rods and Belmont 754-P for rotating steam shafts. TRY THEM NOW!

Write on your company letterhead for Belmont Catalog No. 40 which describes Belmont Packings for all services—a text book guide on applications. An authorized Belmont distributor will be glad to show you samples and help you with *your* particular requirements.

BELMONT PACKINGS

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

FOR RECIPROCATING STEAM RODS
BELMONT 30
For reciprocating steam rods where boiler pressure is in excess of 100 pounds, (340 degrees F.)
FOR ROTATING SHAFTS
BELMONT 754-P
Practical and reliable for rotating shafts, all temperatures.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.

MANUFACTURERS' NEWS

Cincinnati office of The Foxboro Co. has removed to 607 American Bldg., Walnut St. and Central Parkway, phone Main 4872, Mr. Yeatman being in charge.

Fedders-New York Co. at 415 Lexington Ave., New York City, is to represent Fedders Mfg. Co., Inc., New York Blower Co. and Scott Valve Mfg. Co., with John C. Kjerner and Eugene J. Moran in charge.

The Keystone Carbon Co. has just completed a large addition to its factory in Saint Marys, Pa., for the manufacture of brushes and porous bronze bearings. The company has also laid the foundation for another large plant addition which will house new equipment for making negative temperature co-efficient resistors.

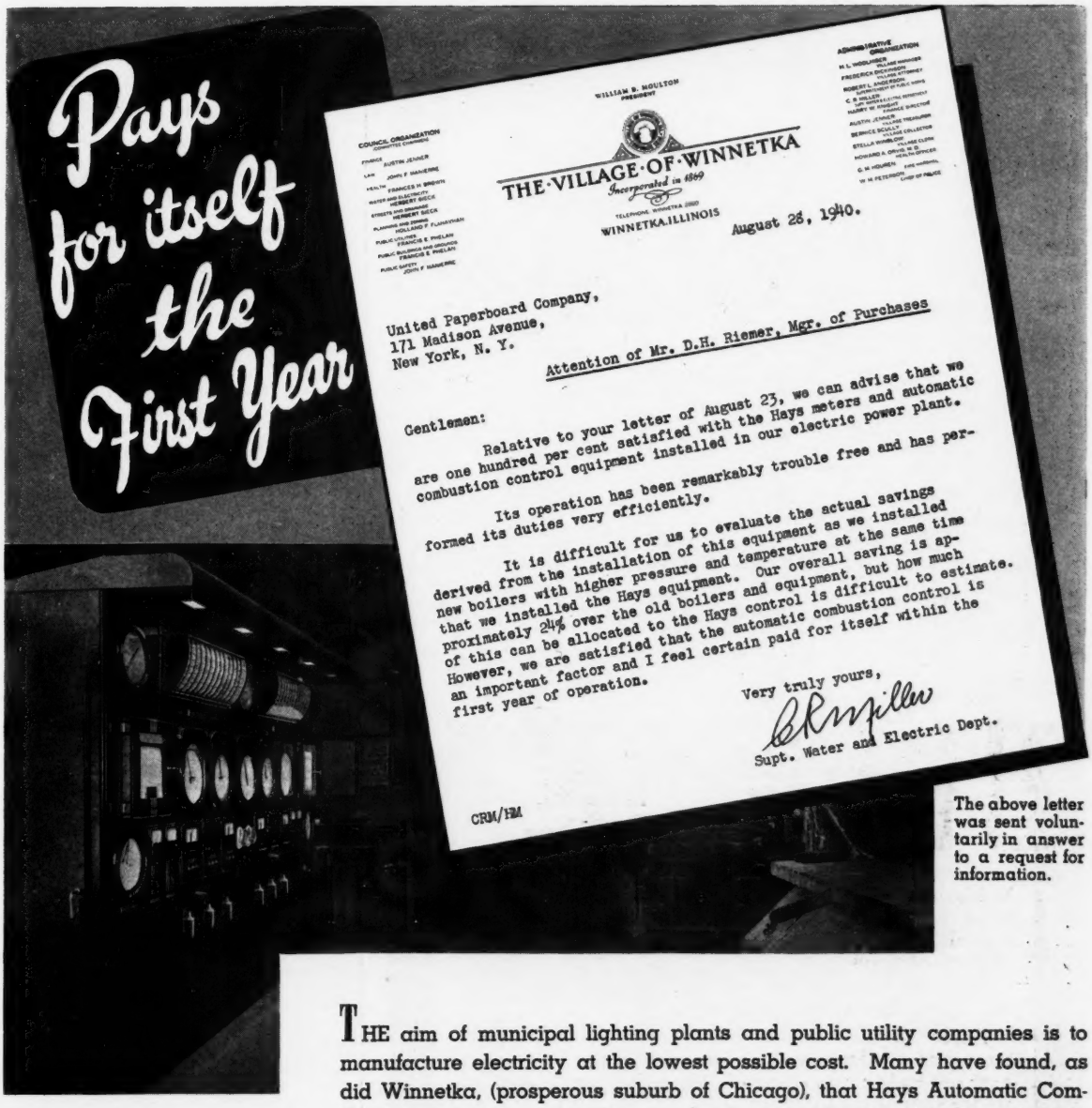
Generators for several plants in TVA are under way at General Electric Co. Three 30,000-kw. units will soon be shipped to Cherokee Dam near Jefferson City, Tenn.; three steam turbine-driven units of 60,000-kw. each are under way for Watts Bar plant near Chattanooga, the first to be completed in October; five hydroelectric units of 32,000-kw. each are contracted as additional equipment for Kentucky Dam near Paducah, Ky., on the Tennessee River, to meet increasing power demand, installation to begin in 1943 and be completed during 1944.

For the new boiler in Manchester Street Station of Narragansett (R. I.) Electric Co., which evaporates 430,000 lb. of steam an hour at 1300 p.s.i. and 915 deg. F., a Griscom-Russell shell-type heat exchanger is used to heat feed water to 400 deg. F. from bled steam at 700 deg. F. At these temperatures Monel metal was thought necessary to stand up under service, resist corrosion and withstand erosion.

H. T. Canfield Engineering Associates, staffed with men of long experience in public utility and industrial fields, has been established at 61 Broadway, New York, to deal with problems involved in the integration of utility systems and changes of ownership, their services including economic and business reports, valuations, cost analyzes. depreciation and rate studies, and regulatory matters and proceedings.

Prudent investment theory, i.e., determination of actual legitimate cost of utility properties and depreciation thereon was adopted as the basis for rate-making valuation. after a 3-yr. investigation, in a decision entered by Federal Power Commission in the case of Chicago District Electric Generating Corp. The Commission announced that it need not try to ascertain other facts bearing on fair value unless it deems such action necessary. Output of the Generating Corp. is sold to Commonwealth Edison Co. and to Northern Indiana Public Service Co., and, because of its favorable condition, allowed return of 5½ per cent on investment was established for rate-making purposes.

Pays for itself the First Year



WILLIAM D. MOULTON
PRESIDENT

THE·VILLAGE·OF·WINNETKA
Incorporated in 1869

TELEPHONE WINNETKA 2060
WINNETKA, ILLINOIS

August 28, 1940.

United Paperboard Company,
171 Madison Avenue,
New York, N. Y.

Attention of Mr. D.H. Riemer, Mgr. of Purchases

Gentlemen:

Relative to your letter of August 23, we can advise that we are one hundred per cent satisfied with the Hays meters and automatic combustion control equipment installed in our electric power plant.

Its operation has been remarkably trouble free and has performed its duties very efficiently.

It is difficult for us to evaluate the actual savings derived from the installation of this equipment as we installed new boilers with higher pressure and temperature at the same time that we installed the Hays equipment. Our overall saving is approximately 2½% over the old boilers and equipment, but how much of this can be allocated to the Hays control is difficult to estimate. However, we are satisfied that the automatic combustion control is an important factor and I feel certain paid for itself within the first year of operation.

Very truly yours,

Supt. Water and Electric Dept.

CRM/HM

The above letter was sent voluntarily in answer to a request for information.

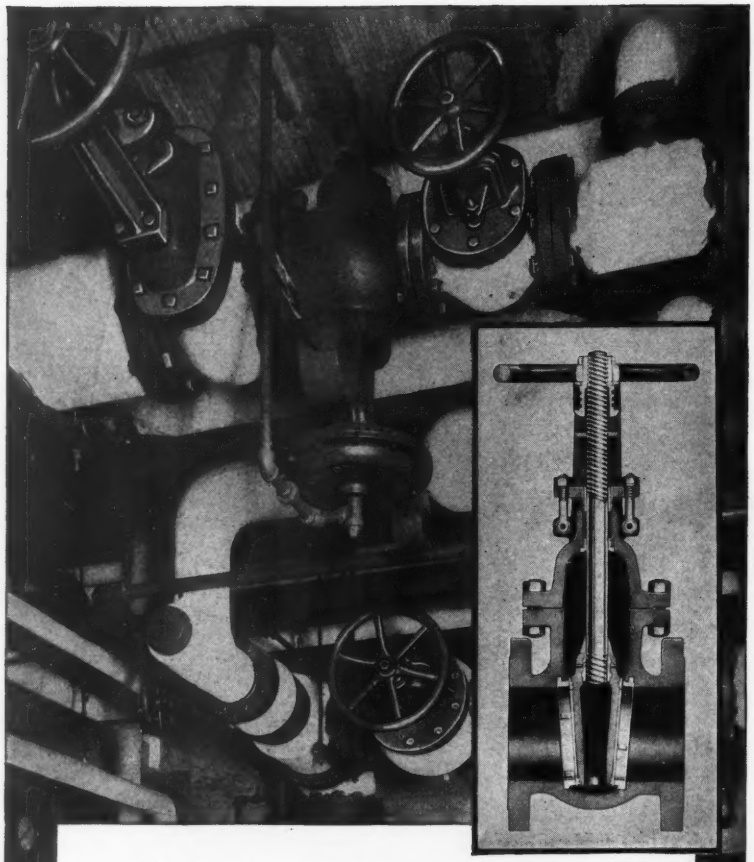
THE aim of municipal lighting plants and public utility companies is to manufacture electricity at the lowest possible cost. Many have found, as did Winnetka, (prosperous suburb of Chicago), that Hays Automatic Combustion Control is a positive cost saver. The supply of steam is kept in step with the demand from the turbine room—plenty of steam when needed, reduced supply at light loads—and combustion always at test efficiency. And Hays Control, being entirely electric, is easy to install, to maintain, and to **understand.** It is applicable to steam generating plants of all types and sizes, burning any type of fuel. Write for information as to how automatic combustion control may be able to improve operating conditions in your own plant.

NOTE TO ENGINEERS:

Tear off the bottom of this ad and mail with your name and address to Hays Corporation and we will send you a copy of "Automatic Combustion Control and its Relation to Lower Steam Costs."

The HAYS CORPORATION

SINCE 1901 — COMBUSTION INSTRUMENTS AND CONTROL — MICHIGAN CITY, INDIANA, U.S.A.



Minimize Service Interruptions

Many years of actual experience with Fairbanks Valves having proved that they eliminated interruptions previously experienced, a leading college installed Fairbanks Valves in their new power house illustrated above.

Here are some of the reasons why men *who know* like Fairbanks Iron Gate Valves.

Acme threads assure easy operation and great strength . . . deep stuffing box with hinge bolts gives easy access for repacking . . . top seat permits packing under pressure when fully open . . . reversible tapered wedge with guide ribs, assures perfect alignment . . . renewable seat rings without threads permit quick, easy removal without removing valve from the pipe line.

For other features write The Fairbanks Company, 393 Lafayette St., New York, N. Y., for catalog No. 21, or get one from our distributors in principal cities.

Fairbanks F
Standard and Renewable **Valves**

Heacon, Inc., Philadelphia, Pa., announces that it is now represented for the sale of the Heacon Damper by the following organizations: Bumstead-Woolford, 1411 Fourth Ave., Seattle, Wash.; Joy & Cox, Inc., 1940 Blake Street, Denver, Colo.; Bell & Eiss, Inc., Foshay Tower, Minneapolis, Minn.; Cochrane Engineering Co., 53 West Jackson Blvd., Chicago, Ill.; Boiler Equipment Service Co., 686 Greenwood Ave., Atlanta, Ga.; Paul B. Huyette Co., 401 North Broad Street, Philadelphia, Pa.

W. B. Simons, Charlotte, N. C., has recently been appointed representative for Cochrane flow meters in the Carolinas, according to announcement from Cochrane Corporation, Philadelphia.

Mr. Simons also handles the products of Hays Corporation, Spence Engineering, Cuno Engineering, Williams Gauge, and the Henszey Co.

Edwin A. Wert has been appointed Vice-President of the Blaw-Knox Co. in charge of Engineering and Sales of its Power Piping Division. Mr. Wert has been a consultant with the company for a number of years and was formerly connected with the Detroit Edison Co., where he had been engaged in an engineering and designing capacity for 18 yr. He has been responsible for the development of numerous technical contributions to piping literature, including simplified formulas whereby economical piping layouts may be quickly conceived, eliminating hours of arduous study.

Yarnall-Waring Co., Philadelphia, announces the following personnel changes in their sales organization: C. Wilson, Jr., formerly of the New York office, has been appointed district manager of Pittsburgh-Cleveland territory and C. N. Maxfield, district manager of Detroit territory, covering Michigan and western Ohio. Bernard R. Bristol and Charles H. Grosjean have joined the New York sales staff; A. E. Robinson, the Chicago sales office and A. L. Aicher, for years a member of the factory engineering staff, the Philadelphia sales office.

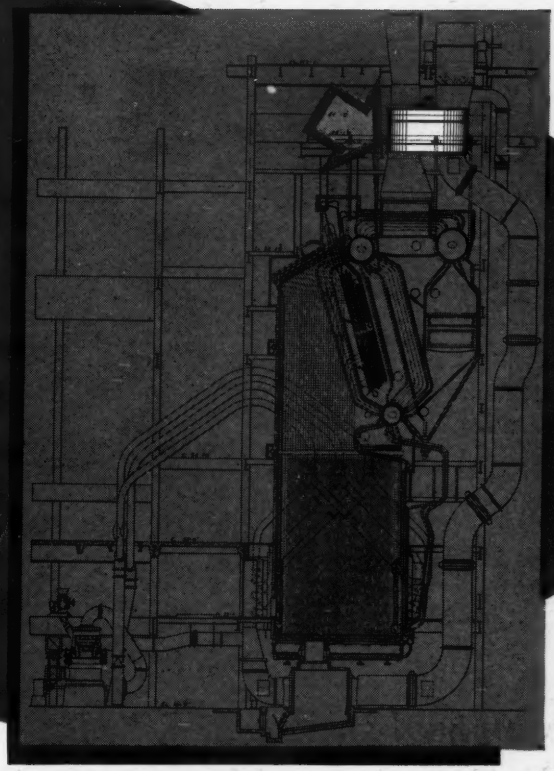
W. J. Thomas, for 9 yr. with the Process Equipment Division of The Babcock & Wilcox Co. at Barberton, Ohio, has been transferred to the executive department of the Sales Offices of The Babcock & Wilcox Tube Co. at Beaver Falls, Pa.

Robert M. Kalb, who for 13 yr. was research engineer of the Bell Telephone Laboratory of New York, has recently been appointed Assistant Chief Engineer of the Kellogg Switchboard & Supply Co. of Chicago. Mr. Kalb is a graduate of Ohio State University, Department of Electrical Engineering, and took post-graduate work at Columbia University. After graduation he taught in the Electrical Engineering Laboratory at Ohio State University.

C. A. Butcher, former Eastern District service manager of Westinghouse, has been appointed assistant manager of the district manufacturing and repair department with headquarters at East Pittsburgh. Born in Des Moines, Iowa, Mr. Butcher received his B. S. degree in Electrical Engineering at Iowa's State College in 1915 and joined the company in 1917 as a salesman in the railway division in Chicago.

14 up and 8 to go

is the score at Philadelphia



Fourteen Ljungstrom Air Preheaters are now in service for the Philadelphia Electric Company. Eight more will go in at the new Southwark Station.

At Chester Station, Richmond Station, Schuylkill Station, and now again at Southwark, Ljungstrom Air Preheaters have been selected to aid in high-efficiency heat recovery on modern steam generating units. Typical of the service which these preheaters perform is the Schuylkill installation shown above. Two steam generators like this each have a capacity of 600,000 lb. of steam per hr., and each unit is equipped with two Ljungstrom Air Preheaters. At the capacity rating, gases enter the preheater at 712° F., leave at 375° F., heating combution air to 528° F.

• • • • •

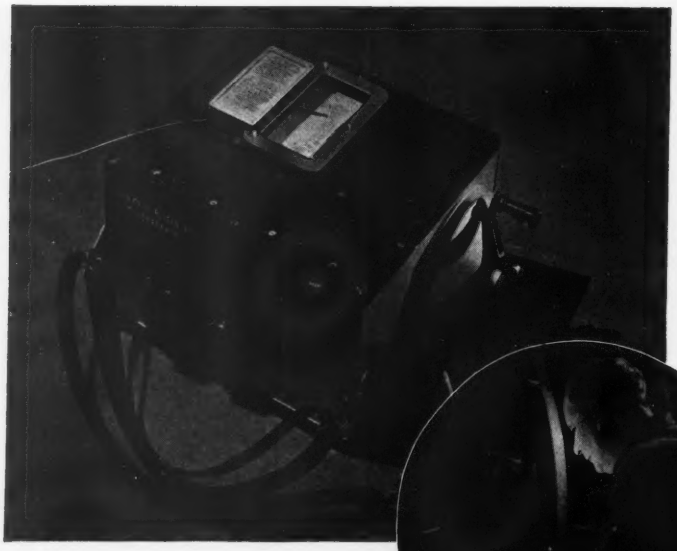
Philadelphia Electric Company was one of the first users of this *continuous regenerative counterflow* type of air preheater, recognizing right from the start the basic thermal efficiency of this type of unit in obtaining high heat recovery in less space with less weight. Moreover, as a result of continual improvements in mechanical design, the *modern* Ljungstrom Air Preheater is now accomplishing efficient heat-transfer with the mechanical dependability that leads to substantial savings in the over-all economic balance.

Evidence of the clear-cut margin of advantage now favoring the Ljungstrom is naturally best known to those who have a long-time experience with these units. The fact that so many leading utilities like Philadelphia Electric Company continue to re-order them, shows how this evidence stacks up.

Whatever your own conditions of boiler-plant operation . . . capacity . . . type of fuel and firing . . . variability of load . . . they are probably closely similar to a Ljungstrom-equipped unit now in service. Why not let us give you a straightforward resume of Ljungstrom performance on a unit similar to the one you plan to install? Just write us for the facts.

THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd St., New York, N. Y. **Plant: Wellsville, New York**



The

"BRIDGE-MEG"

RESISTANCE TESTER

— a combined "MEGGER"* Insulation Tester and Wheatstone Bridge

Range—.01 Ohm to 200 Megohms

For industrial and other engineers who have electrical equipment to install and maintain—here is a *complete* resistance-measuring outfit all built into one portable set that weighs only about 13 lbs. With it you can test the insulation of all types of electrical equipment and detect and forestall trouble. You can measure coils, contacts and relays. You can locate many troublesome faults. The set is portable and rugged—suitable for every day hard use.

Let us tell you more about this unique instrument that has the remarkably wide range of .01 ohm to 200 megohms. Self-contained constant-pressure generator rated 250, 500 or 1000 volts d.c. Write for descriptive Bulletin 1615-PE.

***Trade Mark Registered U. S. Pat. Off.**

James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

National Aluminate Corp. announces that its Senior Vice-President Lt. Colonel P. W. Evans, a reserve officer, has been called in to service and is on duty with the Engineering Corps in Porto Rico.

Association of Consulting Chemists and Chemical Engineers offers free service in supplying advice on consultants to manufacturers confronted with finding materials to use in place of those taken by priorities. Address 50 East 41st St., Room 82, New York, N. Y.

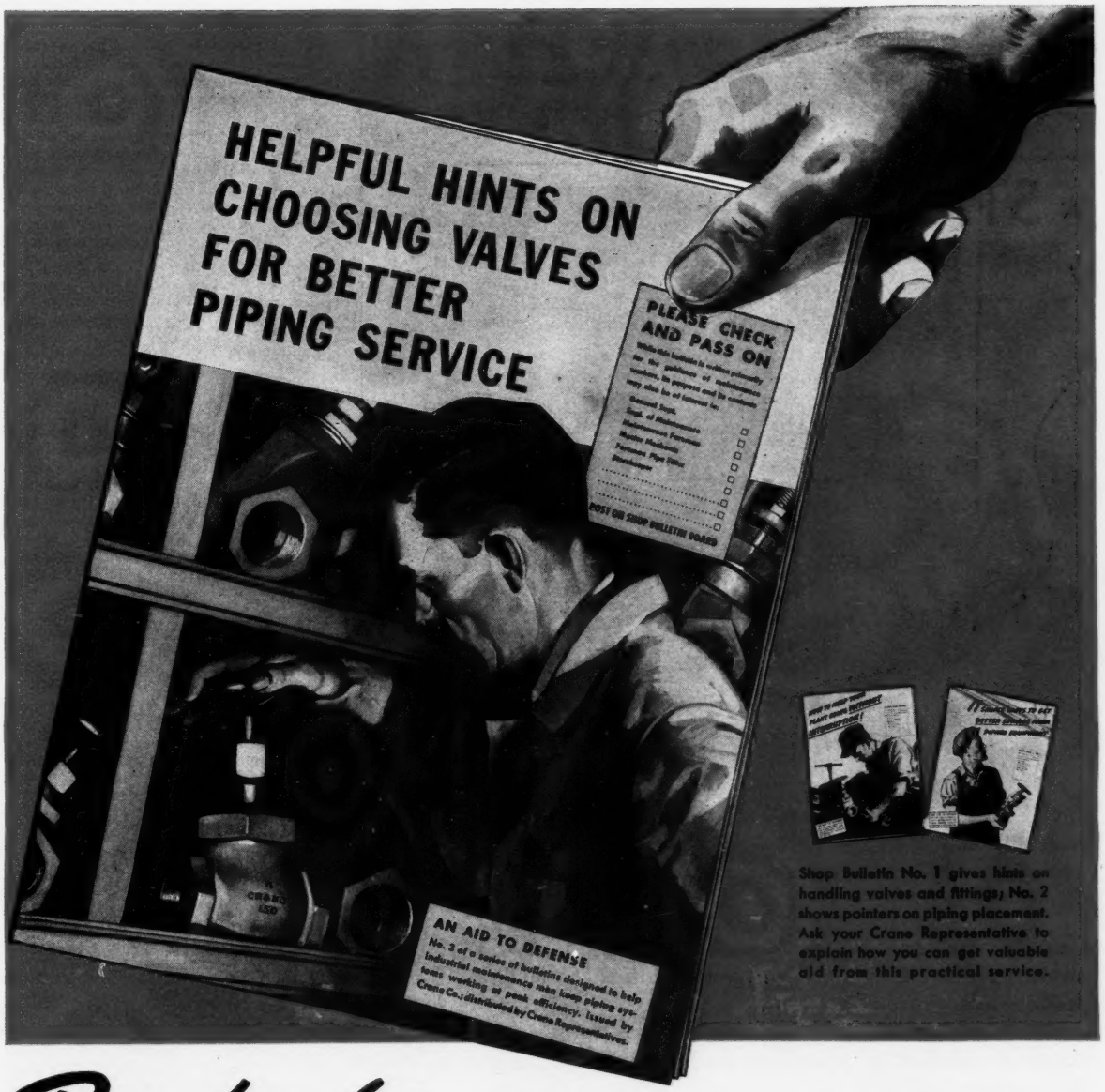
NEWS FROM THE FIELD

Organization of the Indiana Municipal Electric Assn. was started at Tipton, and perfected at a meeting in Frankfort on Oct. 29. Organization committee was Abe Martin of Frankfort, Jesse Tudor of Tipton, Ernie Wells of Pendelton. Temporary officers were Abe Martin, chairman, Jim Caldwell of Rushville, secretary-treasurer, Louis Ramp of Rensselaer, membership chairman, Worth Yoder of Tipton, organization chairman. Priorities, standardization of equipment, credits and emergency exchange of materials were topics discussed.

Flake graphite, hitherto available only from Madagascar and used widely for crucibles, dry cells, foundry facings, lubrication and pencils, may soon be available from Alabama deposits by a new treatment developed at Tuscaloosa experimental station by the Bureau of Mines and Univ. of Alabama.

New equipment has been ordered for completing the 375,000-kw. Shasta plant of the Central Valley, Calif., project. Westinghouse Elec. and Mfg. Co. will supply six 25,000 kv-a. transformers, five 15,000 v., 3200 amp. bus structures with equipment. Allis-Chalmers Mfg. Co. will furnish four 25,000 kv-a. transformers. General Electric Co. will furnish six 25,000 kv-a. transformers. Operation of the plant is scheduled to begin in 1944.

Re-employment of men returning to civilian activities from selective service and from completion of terms of service in the regular army, navy or marine corps is urged as a patriotic duty of employers by Brigadier General Lewis B. Hershey, Director of Selective Service. Men discharged will be given forms to fill out, which will indicate civilian experience and qualifications, with warning not to overrate their abilities, but to give accurate, clear and concise statements. While re-establishment of returning selectees is primarily the job of local service boards, co-operation will be given by State and United States employment offices. Each man should get in touch with his local board re-employment committeeman, and employers should extend a helping hand by listing with local committees jobs available in their plants.


HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE
PLEASE CHECK AND PASS ON
POST ON SHOP BULLETIN BOARD
AN AID TO DEFENSE
No. 3 of a series of bulletins designed to help industrial maintenance men keep piping systems working at peak efficiency. Issued by Crane Co., distributed by Crane Representatives.

Shop Bulletin No. 1 gives hints on handling valves and fittings; No. 2 shows pointers on piping placement. Ask your Crane Representative to explain how you can get valuable aid from this practical service.

Ready for you...

CRANE SHOP BULLETIN NO. 3

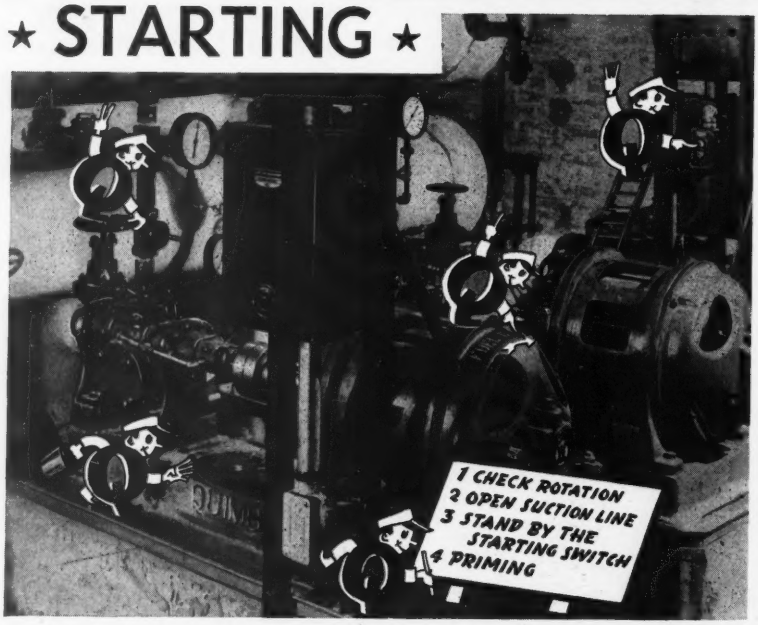
It's ready—to help you keep pipe lines in peak condition for peak production—to help you get maximum service from present equipment. This timely Crane Shop Bulletin Service is designed to aid you in training new maintenance men; and to caution experienced workers on piping fundamentals often overlooked with costly results. Bulletin No. 3 gives many valuable hints on the proper selection and usage of valves. Copies for distribution to your piping crews may be had from your Crane Representative—or by writing to us.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO
VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

★ STARTING ★



FOR the initial start make sure that the motor is wired to rotate in the direction of the arrow. A momentary application of power is sufficient for this test. Do not run the pump dry and never in the wrong direction.

Quimby Rotary pumps are self-priming but the casing should be filled with liquid for the initial start. At all times make sure that suction line joints are tight and that the suction valve is open. Running a pump without liquid will cause overheating and perhaps binding. Quimby centrifugal pumps are not self-priming.

A pump handling hot liquid should be started slowly to give all parts time to expand evenly. Uneven expansion might result in binding. Keep your hand on the starter for at least a minute so that power can be shut off immediately if the pump begins to labor.

CONCERNING DELIVERY: National Defense priority may cause even our oldest customers some delay in delivery. We earnestly request your patient cooperation until our present expansion program can relieve this situation.

QUIMBY PUMP CO.
INCORPORATED
352 Thomas Street
Newark, N. J.

QUIMBY SCREW PUMPS

. . Good Pumping Practice Since 1894 . .

Employers who are facing possible layoffs of workers because of shortage of materials are urged by Federal Security Administrator Paul V. McNutt to report their problem to the nearest State employment office as a first step to obtain government action to utilize the workers for defense production. Analysis of threatened plants in various parts of the country showed them to be small firms, with under 500 workers, in small, one-industry towns, making largely household equipment and small foundry work.

Since in many instances any re-employment opportunities would involve removal to a considerable distance, effort is being made to allocate sub-contracts for defense production such that present plants can be converted to that use.

At Paterson-Leitch Co., Cleveland, arc welding has been adopted in fabrication of coal hoppers in place of riveting, with reduction in time and improvement in appearance. Parts previously cast are also now welded with G-E arc welders and electrodes, giving reduced weight and sturdier construction, also eliminating patterns and casting operations.

Bureau of Standards recommends 17 stock sizes of wire in the range from No. 14 to 500,000 cir. mils, with no sizes above 500,000 cir. mils to be stocked, but available on order. Copies of R180-41, recommendation for simplified practice in copper conductors, may be obtained from Supt. of Documents, Government Printing Office, Washington, D. C., for 5 cents a copy.

Construction of Grand Coulee Dam, begun in 1933, is 99 per cent completed and will be finished 2 yr. ahead of schedule. Placing of the 10½ million cu. yd. of concrete will be completed within a few months and the first 108,000-kw. generating unit was placed in service recently. Two more units are in process of assembly and others will be installed as needed.

On October 16 the Carborundum Co. dedicated an educational exhibit, telling the story of modern manufactured abrasives which has been installed at the Chicago Museum of Science and Industry. One of the striking features of the exhibit is the reproduction of the laboratory of the late Dr. Edward Goodrich Acheson in which he created the first man-made abrasive silicon carbide to which he gave the name carborundum. A revolving mound of colored crystals of Carborundum Brand Sicon Carbide is displayed on a circular base of black marble. Detailed processes are shown in a series of diagrams, and in a demonstration booth are shown grinding processes.

Pittsburgh, Pa., smoke ordinance went into effect Oct. 1, providing that industrial plants may emit only a very light gray smoke and that new installations of heating equipment must have devices to burn fuel smokelessly or must burn smokeless fuel. A 12-man Bureau of Smoke Prevention, headed by Sumner B. Ely of Carnegie Institute is in charge of enforcement.

(Continued on Page 130)

Those tangents on WeldELLS are for you!

THE accurately formed straight segments on each end of every WeldELL are placed there for your benefit—to give you better engineered piping at lower cost.

They keep the weld away from the zone of highest stress, make lining up easier and facilitate the use of slip-on flanges with WeldELLS.

Tangents provide just one of *eight* good reasons for insisting on WeldELLS. Seven other extra value features are listed below.

►WeldELLS and other Taylor Forge Fittings for Pipe Welding and Forged Steel Flanges are stocked by authorized distributors in all principal cities. Ask your local distributor for a copy of Taylor Forge Catalog No. 401.

TAYLOR FORGE & PIPE WORKS, General Office & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

WeldELLS have *everything*—

No other fittings for pipe welding combine these eight features. In addition to tangents these features are:

1. **Seamless**—Greater strength and uniformity.
2. **Precision quarter-marked ends**—simplify layout and help insure accuracy.
3. **Selective reinforcement**—provides uniform strength.
4. **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
5. **Wall thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provide best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

BACK TO WORK THESE USED DARTS GO

We would like to make a suggestion—in the interest of the conservation of metals for National Defense.

Maybe, somewhere around your plant, there are some scrap piles of old pipe on which there are also discarded unions. Our suggestion is that these pipes be examined and if any *Dart* Unions are found, have them removed and put back into active service.

Dart Unions have been designed and manufactured to be re-installed over and over and over—and give the same high satisfaction, the same "first-time" tightness, each time. Dart's matched bronze seats, ground to "true-ball" surfaces sees to *that*. And the fact that Dart bodies and nuts are made of air refined malleable iron explains why Dart Unions resist pipe strains, rust, abuse—and reach such a ripe old age.

Understand—we make the suggestion that you find and re-install your used Darts purely in behalf of metal conservation. If you need to invest in additional Darts, get in touch with your local supplier. Because of the way Dart Unions are made—and what they are made *of*, Darts *do* constitute an investment that pays big dividends, for a long time.

DART UNIONS

E. M. DART MFG. CO. Providence, R. I.

Sales Agents: The Fairbanks Company New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Boiler Water Columns—New Catalog No. 45 pictures and describes the applications of Ernst adjustable water gages, water columns, try cocks, and safety guards. It shows how to avoid shutdowns by keeping boilers in service under all conditions. Ernst Water Column & Gage Co.

2 Industrial Stokers—F & E underfeed stokers for industrial boilers are described in Catalog 1204. Contains typical installation diagrams. Flynn & Emrich Co.

3 Super Refractories—Many charts on thermal conductivity and expansion of refractories and other helpful engineering data are included with descriptions of Carborundum refractories for heavy duty service given in a 76-pp. catalog. The Carborundum Co.

4 Automatic Combustion Control—A new, 8-pp. bulletin DR-39, featuring Hagan Automatic Combustion Control gives a fresh slant on combustion control as applied to the size and type of installations found in the majority of industrial plants. Combustion principles and functions of automatic control; descriptions and layouts of typical, modern control installations for boilers employing all types of fuels; and applications of Hagan equipment are given. Hagan Corp.

5 Facts on Fuel Saving—For more steam on less coal investigate the information and catalog offered on underfeed and pneumatic spreader overfeed stokers. Catalog 140 also available covers applications of Poweram stokers which combine easy-flow worm feed and ram distribution. Free boiler room survey. Iron Fireman Mfg. Co.

6 Baffle Walls—Bulletin B-40 tells how and why Enco streamlined baffle walls avoid eddy currents and eliminate dead gas pockets; help new and old boilers deliver more steam at lower cost. The Engineer Co.

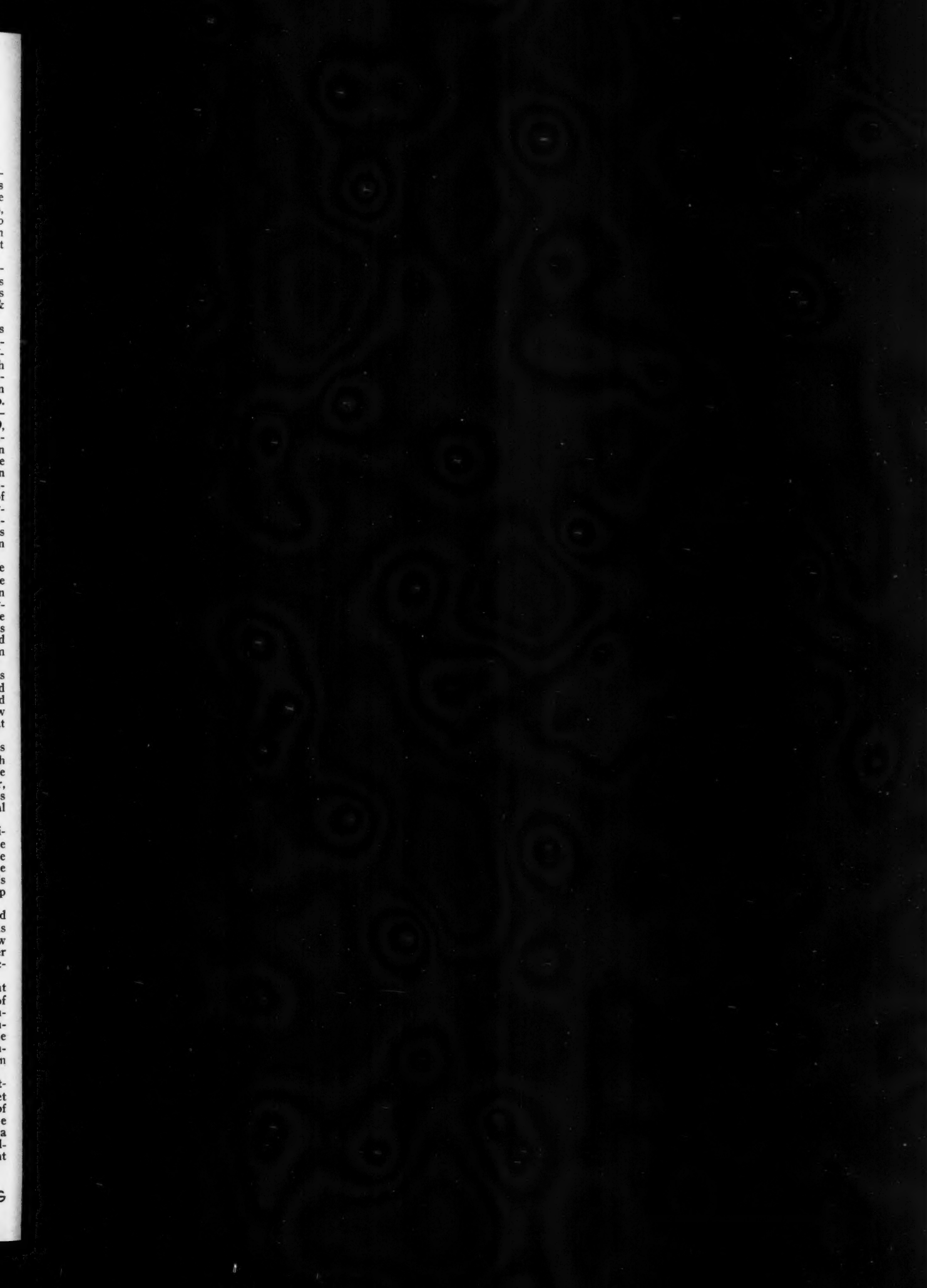
7 Coal Burners—Data gives facts in detail on the Fyr-feeder which incorporates features of adjustable feeder, multiple pneumatic spreader, and control of coal distribution. Burns cheapest coal sizes and reduces coal bills. American Coal Burner Co.

8 L-Type Boilers—Settings of typical installations of Union L-type boiler for various methods of firing are illustrated in Bulletin No. 34-b. Due to compact design, many sizes of this boiler can be shipped completely shop assembled. Union Iron Works.

9 Low Pressure Heating—Illustrated bulletin covers typical installations of McClave stokers and grates on low pressure heating systems for either large or small boiler units. The McClave Co.

10 Fuel-Firing Check Chart—Recent bulletins present data on each of 12 factors influencing economical, continuous steam generation. These include fuel flexibility, capacity, refuse disposal and other factors in determining "balance of power". American Engineering Co.

11 Traveling Grate Stoker—Attractively illustrated 28-pp. booklet covers unusual design characteristics of Riley-Harrington traveling grate stoker. Also includes performance data from seven varied installations. A valuable reference book for steam plant engineers. Riley Stoker Corp.



HELPFUL BULLETINS

Many useful engineering bulletins and catalogs are offered in the news and advertising pages of POWER PLANT ENGINEERING. For your convenience we publish the following summary of such literature mentioned in this and recent issues. To obtain copies of these bulletins and catalogs described simply indicate the paragraph numbers on the card below, detach and mail.

12 Boilers and Water Walls—Catalog No. 35, showing details and typical general arrangement of boilers, details and typical general arrangement of boilers and water walls for different fuel burning equipment. Also articles in pamphlet form covering different boiler and power plant installations. New bulletins available. Springfield Boiler Co.

13 Combustion Control—In a 108-page well-illustrated textbook on combustion control, principles and operation of Republic-Smoot combustion control are discussed in detail. It also includes installation reports on outstanding plants that contain photographs and large blueprints showing how the controls are applied to all types and sizes of boilers and auxiliaries and all methods of firing. Published as Data Book No. S-21 by Republic Flow Meters Co.

ELECTRICAL EQUIPMENT

14 Motors—GEA-3488, entitled "How to Maintain DC Motors," covers selection, inspection and maintenance of dc motors, designed to make motors give better service longer. Trouble-correction chart gives cause, symptom and remedy for numerous motor troubles. General Electric Co.

15 Safety Switches — A Condensed Catalog 411, 92 pp., covers the line of safety switches, lighting panels, switchboards and other electric products. Contains handy formulas and data tables of interest to engineers. Bull Dog Electric Products Co.

16 Fluorescent Lighting — The new catalog of lamps and equipment provides a complete story on the design of a system of fluorescent illumination. Over thirty types of luminaires are described. A valuable guide for engineers with industrial lighting problems. Hygrade Sylvania Corp.

17 Transformers — Bulletin GEA-3650, describing General Electric's complete line of outdoor-type current and potential transformers of 15 kv. and below is available in accordion-fold to allow insulation characteristics, accuracy classifications, ratings and prices of the various units to be seen at a glance. General Electric Co.

18 Fluorescent Lighting—Fluorescent luminaires using a 40-watt, 48-inch lamp are described in a new 2-pp. leaflet, Catalog Section 61-152. The units consist of a hood, reflector, lamp holder, lamp starters and ballast equipment. They are intended primarily for lighting areas in industrial plants. Westinghouse Electric & Mfg. Co.

19 Insulated Wire and Cable—Catalog No. 10-E describes the complete line of Rockbestos permanently insulated wires, cables and cords for industry. Dimension tables and other data helpful in planning wiring for boiler rooms, power plants, steel mills, etc. Rockbestos Products Corp.

20 Transformers—Core and coil construction of Allis-Chalmers circular coil, shell type high voltage power transformers are fully described in a new 20-pp. Bulletin, B6171. Fully illustrated the catalog also shows details of construction. Allis-Chalmers Mfg. Co.

21 Electrical Machinery Handbook—48-pp. "Catechism of Electrical Machinery" explains electricity and magnetism as utilized in electric generators and motors, and goes on to discuss important electrical measurements. The principles of direct-current generators and motors are presented next, followed by an A-B-C examination of alternators and alternating-current motors. Illustrations are generously used as aids to clear understanding. Useful tables of practical application are included. Fairbanks, Morse & Co.

FANS, PUMPS AND COMPRESSORS

22 Industrial Pumps — Practical information concerning pump adaptation for a wide range of duties under varying conditions is the theme of the new Pomona industrial catalog just published. Contains many illustrated case histories of varied applications; also practical drawings for laying in this type of pump. Pomona Pump Co.

23 Compressors — Bulletin No. 192, 24 pp., describes horizontal, duplex, double-acting, water-cooled air or gas compressors for either single or 2-stage compression, with photographs and diagrams. Pennsylvania Pump & Compressor Co.

24 Steam Driven Compressors—New Bulletin No. 200-73 pictures and describes the Clark "angle" unaflow steam engine driven compressors. Built in 3, 4, 5, 6 and 8 cylinders and up to 4000 b.hp. More economical operation, less floor space and reduced installation cost are advantages claimed. Clark Bros. Co., Inc.

25 Mechanical Draft — Bulletin No. 456 reproduces a series of advertisements describing typical installations of Sturtevant mechanical draft fans in many of America's outstanding power plants. Shows how extra capacity or fuel savings can be had from present boilers. B. F. Sturtevant Co.

26 Rotary Compressors—Fuller rotary air compressors for pressures to 125 lb. are fully described in Bulletin C-3A. Pictures typical installations. Fuller Co.

27 Air Compressors — The Wayne "300" series of air compressors is fully described in a new illustrated 16-pp. bulletin. These compressors, with capacities up to 26 cu. ft. per min., are widely used in office buildings, packing plants, machine shops, etc. The Wayne Pump Co.

28 Ventilators — "Air-Van Blowers Move Air Like Magic" is the title of a 4-pp. bulletin describing a new motor driven ventilator with simple, economical construction and large air volume. Made in eight different sizes with motor horsepowers ranging from 1/20 to 5; free air capacity of from 435 to 15,000 c.f.m. The Gallaher Co.

INSTRUMENTS AND CONTROLS

29 Recording Instruments — Catalog entitled TAG Recording Instruments for Temperature and Pressure, No. 1210, has just been published, giving latest developments, with new line of thermometers, pressure gages with 9, 10 and 12-in. charts and data on mercury, fully-compensated mercury, vapor tension and gas-filled tube systems. C. J. Tagliabue Mfg. Co.

30 Control Specialties — Shown in Catalog 35 are Fisher pressure reducing valves, back pressure valves, check valves, steam traps and other control specialties for all services and pressure conditions. Fisher Governor Co.

31 Gages For Measuring Liquids—Bulletin 1037 describes a complete line of liquid level gages for measuring liquids of all kinds whether light

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or heavy. Dial reading can be provided in feet, inches, gallons, pounds, liters, or any other desired increment. The Liquidometer Corp.

32 Indicating Instruments — Folders 50-A and 80-A show operating features of Rotameter—an electrically operated instrument for remote indicating, recording, integrating, automatic flow control. Includes charts, conversion factors and other engineering data. Fischer & Porter Co.

33 Automatic Coal Scales—How to stop preventable coal wastes with the improved Richardson automatic coal scale is outlined in Bulletin R21240. These scales come in sizes and types to suit every boiler room layout. Richardson Scale Co.

34 Automatic Controllers — Catalog No. 8903 on Air-Operated Controllers for temperature, pressure, flow, liquid level, humidity, contains 36 pp. of information on plant operation. Descriptions are clear and concise with photographs of instruments and installations and schematic diagrams to show the principle of operation. The Brown Instrument Co.

35 Combustion Meters or CO_2 Recorders—New 16-pp. booklet describes what a combustion meter is, the work it performs, and the points to check in selecting a satisfactory meter. Also contains an accurate description of the operation of the orsat principle in the measurement of carbon dioxide and how this principle is carried out by the Hays Combustion Meter. Publication No. 41-550, The Hays Corp.

36 All-Metal Thermometers — Unaffected by severe vibration and over-temperatures, a line of industrial temperature gages needs no correction for capillary attraction or heat transfer from stem. Available in sizes, ranges and types for all plant requirements. Booklet giving complete description sent free upon request. Weston Electrical Instrument Corp.

MECHANICAL TRANSMISSION

37 Speed Reducers—An 8-pp. booklet emphasizes operation of Cleveland Worm Gear Reducers and reports graphically the conditions under which worm gear driven machinery must operate in each particular industry. Cleveland Worm & Gear Co.

38 Belting—4-pp. leaflet gives results of laboratory tests which show that belt-life decreases rapidly if less than the normal number of V-belts are used. Worthington Pump & Machinery Corp.

39 Gear Type Coupling—Folder No. 9 describes greater oil capacity, long life of Waldron gear type couplings for drives on all classes of equipment. John Waldron Corp.

40 V-Belts — 24-pp. booklet gives graphic story of Veelos, adjustable V-Belt made by company. Various applications shown. Method of installation pictured, and advantages over other type belts given. Manheim Mfg. & Belting Co.

PIPING, VALVES AND FITTINGS

41 Flexible Piping—New 12-pp. Bulletin 71 gives 1942 Standard Data on Penflex All Metal flexible pipes for Diesel installations for: fuel oil, starting air; lube oil; exhaust and air intakes, etc. Pennsylvania Flexible Metallic Tubing Co.

42 Unit Heaters — Data book gives complete description of 3 types and 30 sizes of unit heaters for every heating need, and presents underlying principles, advantages and economies of unit heating; listing 14 points of superiority of Thermolier unit heaters. Grinnell Co., Inc.

43 Automatic Valves — New illustrated Catalog 70 covers design and operating feature of Foster reducing valves, temperature regulators, pump governors, relief valves, back pressure valves. Also contains steam flow charts and other practical engineering data. A copy will be sent to engineers and executives in industries serving national defense if request is written on their company letterheads. Foster Engineering Co.

44 Steam Heating Equipment—Catalog No. 36 explains with photographs and diagrams how thermostatic, float and other type traps are used to improve efficiency of steam heating systems. Also contains tables on properties of saturated steam and engineering data. William S. Haines & Co.

45 Air Conditioning—Industrial comfort and industrial processing atmospheres as provided by the Kathabar System are described in Bulletins K-41-2 and K-41-3. Surface Combustion Corp.

46 Boiler Tubes—Bulletins tell about the analyses, sizes and shapes of Electrunite electric resistance welded tubes for boilers, heat exchangers, superheaters, evaporators and condensers. Steel & Tubes Division, Republic Steel Corp.

47 Steam Traps—Catalog No. 941 illustrates and describes traps of thermostatic type and their applications, self-cleaning strainers, expansion steam traps, weight-operated steam, air and gasoline traps, and piston operated steam traps. Also included are dimensions and capacities. W. H. Nicholson & Co.

48 Pipe Units—Catalog No. 41 contains complete data on all approved types of construction on underground conduit systems for steam and hot-water lines, with special emphasis on Ric-Wil pre-sealed insulated pipe units. Ric-Wil Co.

49 Welding Fittings—Bulletin WF-41, gives complete information on welding fittings (ells, tees, flanges, nipples, return bends, etc.) that improve design and reduce cost of piping systems. New fittings of this company not previously available are described. Midwest Piping & Supply Co., Inc.

50 Valve Specialties—New Davis revised Catalog of valve specialties includes complete information on pressure regulators; altitude valves; pump governors; strainers; lever, float and motor-operated valves; pilot valves; back pressure, relief and non-return valves; steam traps; liquid level controllers; diaphragm motor valves; solenoid valves and oil and gas field specialties. Also featured are technical data on capacities, drilling and temperature schedules. Davis Regulator Co.

51 Piping Maintenance Bulletins—Timely assistance in getting better service from piping equipment is given in three recently issued Bulletins: No. 1 gives hints on installation methods; No. 2 covers pointers on correct piping placement; No. 3 guides in valve selection and usage. Crane Co.

52 Heaters — Bulletin No. 1030 describes products which include heat exchangers, evaporators, vapor condensers, oil coolers and heaters. American Locomotive Co.

53 Butterfly Valves — Described in new Bulletin 8-B are the low cost and easy operation of R-S Butterfly valves for regulating and shut-off duty on pulverized fuel, flue dust, steam and hydraulic service. Sizes up to 84 in. in diameter. R-S Products Corp.

54 Piston-Ring Expansion Joint — Fully described in Catalog No. 35E is the Adsco piston-ring expansion joint, which is claimed to be the only slip type joint that can be packed under pressure. American District Steam Co.

PRIME MOVERS

55 Solid Wheel Turbines — Bulletin S-116 illustrates and describes application, construction, savings effected and advantages of the Terry solid wheel turbine. The Terry Steam Turbine Co.

56 Multistage Turbines — De Laval multistage turbines, in capacities up to 15,000 hp., are fully described in Publication T-3522. In medium and large capacities they can be directly connected to alternators. In smaller capacities, or for driving d.c. generators a De Laval speed reducing gear makes for maximum efficiency. De Laval Steam Turbine Co.

57 Diesel Engines—In Bulletin S-500-B38A are illustrated and described Worthington 4-cycle, direct-injection, totally enclosed DD Diesel engines,

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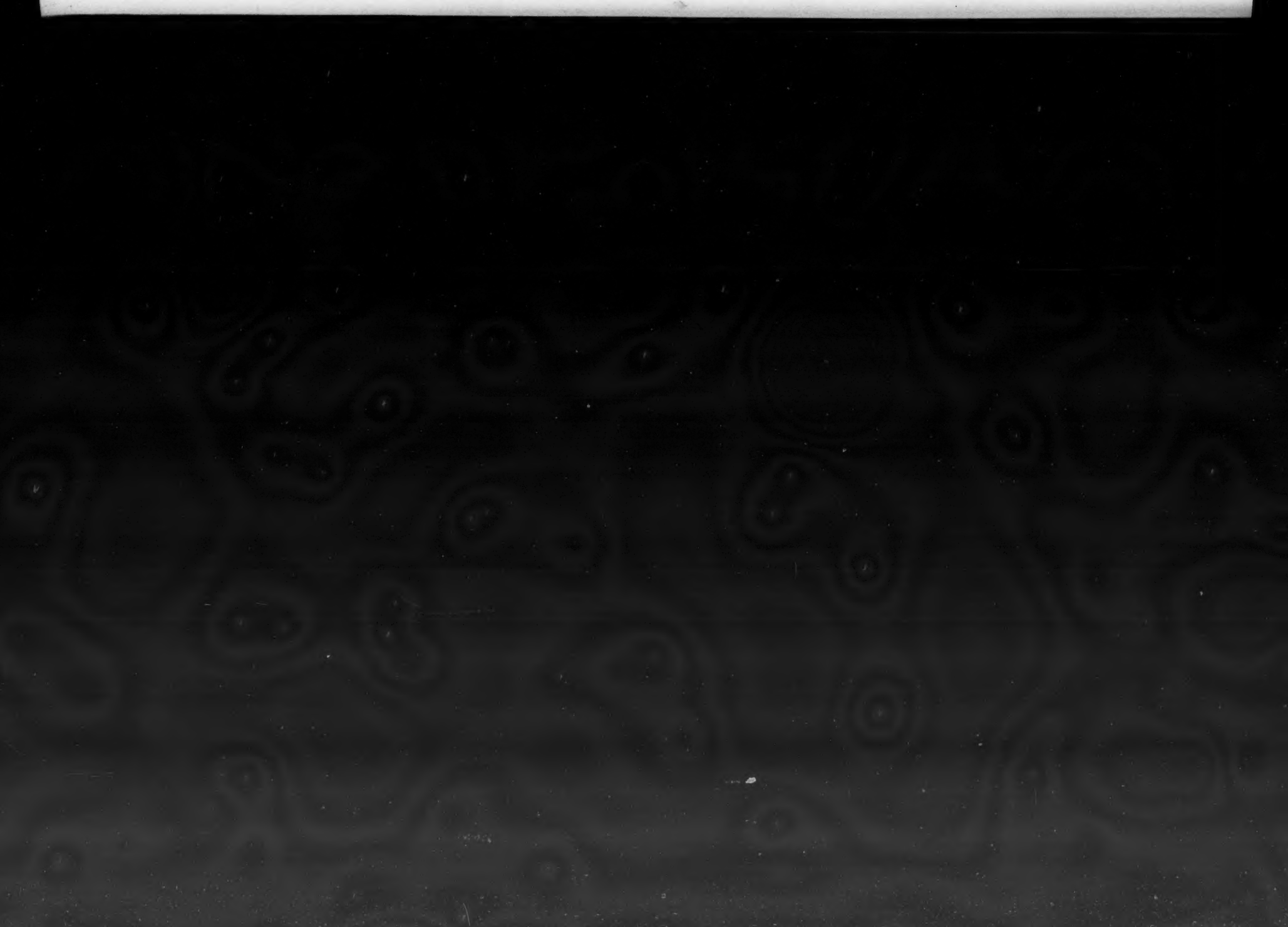


giving details, sizes and horsepowers. Worthington Pump and Machinery Corp.

58 Steam Engines—Two recent bulletins, "Modern Steam Engines" and "½ cent per Kilowatt hour power cost" deal with the flexibility, sustained overload capacity and economy of Troy-Engberg steam engines. Troy Engine & Machine Co.

WATER TREATMENT

59 Feedwater Treatment — Booklet "Silica vs. Phoscaloid" tells an interesting story of the early history of feedwater and the development of Phoscaloid, a popular after treatment for all types of lime-softening plants. Cyrus Wm. Rice & Co.

60 Water Softening—Cochrane Publication 3000, Hot Process Softening, describes many unique applications of feedwater treatment. Also discusses boiler feedwater analyses and their interpretation. A valuable reference book for steam plant engineers. Cochrane Corp.

61 Corrosion Control—How to stop the waste of chromium ore by using chrom glucosate for corrosion control is discussed in recent bulletins. D. W. Haering & Co.

62 Water Treatment — A thorough discussion of Monongahela River water and how its character relates to its industrial use is given in a new, 16-pp. booklet entitled "Monongahela River—Steel Plant Water Supply." Discusses factors influencing the character of the river water and the water-conditioning problems involved in its use particularly in boiler feedwater and cooling water systems. Map, charts, water analyses tables and bibliography are included. Hall Laboratories, Inc.

63 Chemical Feeders — Bulletin No. 122 illustrates and describes Proportioneers chemical treating and feeding systems for power plants. It includes the handling of phosphates, sulphites, sulphates, sulphuric acid, etc. A valuable reference bulletin for engineers on problems of scale, pitting and corrosion, carry-over. Proportioneers, Inc.

MISCELLANEOUS

64 Metals—Methods for the fabrication of clad steel plate such as nickel-clad steel, monel-clad steel and inconel-clad steel are given in recently issued Technical Information Bulletin T-4. International Nickel Co., Inc.

65 Tanks and Pressure Vessels—Newly issued 8-pp. bulletin shows many types of tanks, heat exchangers, condensers and pressure vessels available for use in chemical and process industries, power plants. The Patterson-Kelly Co., Inc.

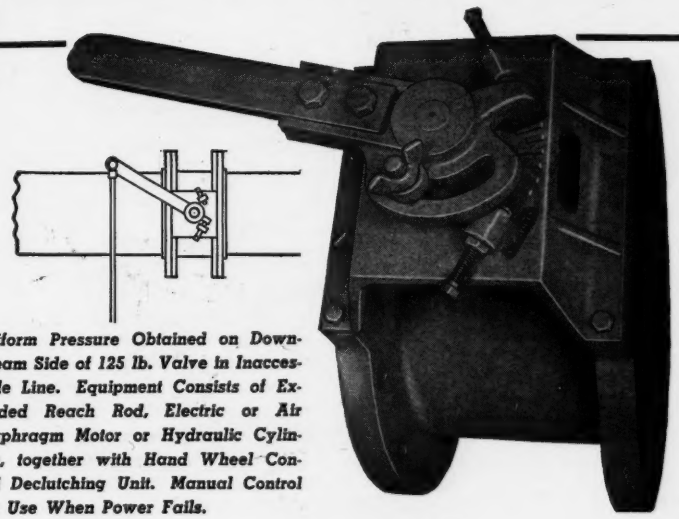
66 Water Coolers for Diesels — Attractively illustrated 16-pp. bulletin shows construction features of new Fairbanks-Morse evaporative coolers for Diesel engines. Contains tables of water cooling capacity, piping diagrams and other useful data. Fairbanks, Morse & Co.

67 Engineering Memoirs — "A Century Ago" is the title of an engagingly written and illustrated anniversary booklet covering the memoirs of Erastus Beethoven Badger, early coppersmith and steam engineer. E. B. Badger & Sons Co.

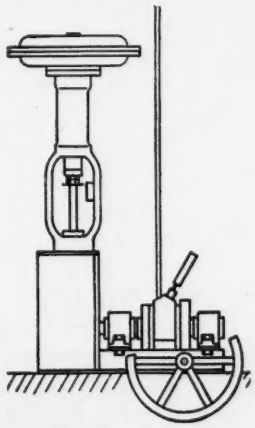
68 Hand Book of Building Maintenance—74 pp. of technical information for Plant Managers. Main-

(Continued on page 128)

WEDGE-TIGHT SHUT-OFF with one thrust of lever



Uniform Pressure Obtained on Downstream Side of 125 lb. Valve in Inaccessible Line. Equipment Consists of Extended Reach Rod, Electric or Air Diaphragm Motor or Hydraulic Cylinder, together with Hand Wheel Control Declutching Unit. Manual Control for Use When Power Fails.



R-S Butterfly Valves provide a full flow when open and quick shut-off action. The diameter of the valve is the same as that of the line and the frictional resistance is low due to the streamlined vane. There are no troublesome pockets, seats or obstructions to retard the flow. One thrust of the R-S hand lever or six revolutions of the R-S hand wheel completes the full movement of the butterfly vane—no easier operated or faster acting shut-off and control valve is manufactured.

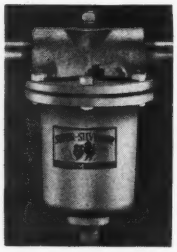
Suitable for steam, oil, water, gas and semi-solids under a wide range of pressures and temperatures. Shut-off is wedge-tight because of accurate machining and the angle of closing of the vane against the body of the valve. Can be used in process and feed water lines, equipment outlets and solenoid emergency shut-off duty. The cost is low, compared with conventional type valves. Write for new catalog 10-B and the name of our nearest representative.

R-S PRODUCTS CORPORATION
4535 Germantown Ave., Philadelphia, Pa.

R-S BUTTERFLY VALVES

Precision Machined and Wedge-Tight

● Maybe you *should* have new unit heaters—but can't get delivery. Maybe you *have* to make the best of present equipment—and it just does not turn out enough heat. That's when you want more zip in those old unit heaters. You can get it!—by replacing inefficient steam traps with modern, steam saving, "unit-heater-energizing" Anderson Super-Silvertop traps.



In a careful test, Super-Silvertops increased heater output 25 per cent over the output using a good quality temperature actuated steam trap. Super-Silvertop operates on the presence of water or air—not the temperature. There's no time lag waiting for air or water to cool off to a critical point. If you need more zip in your present unit heater—or full rated capacity from new heaters—get what you want with Anderson Super-Silvertop inverted bucket steam traps. Write for book—"How To Choose a Steam Trap."

THE V. D. ANDERSON COMPANY
1939 West 96th Street • Cleveland, Ohio

Super-Silvertop
STEAM TRAPS

Looking Ahead . . .

In the power field, perhaps more than in other basic industrial fields, the continuous betterments in machinery and methods compel men to look ahead with broader vision and greater determination than ever before.

Reading the advertising messages that appear in POWER PLANT ENGINEERING will keep you informed on new trends and opportunities. Month after month, these advertisements describe what's new in generating, transmitting power. They will help you and your plant join the onward march of the power plant industry.

tenance Men and Superintendents. Shows how to do hundreds of odd jobs at lower cost with better results. Presents many ideas that save valuable time and materials. Over 150 pictures, diagrams, mechanical drawings. Non-technically written. Flexrock Co.

69 **Rail Clamps** — Rail clamps both hand-operated and automatic, used to hold carriages of unloaders, cranes, material-handling towers and bridges to the fixed structure when stationary, are described in Bulletin No. 114. Robins Conveying Belt Co.

70 **Oil Clarifier** — Industrial Catalog 1019 contains descriptions of Briggs clarifiers for fuel and lube oils. Also many tables and charts of interest to engineers interested in lubrication. Briggs Clarifier Co.

71 **Industrial Lubrication**—Newly issued bulletin describes Albany lubricants for industry; includes handy recommendation chart for lubricating compressors, conveyors, pumps, shafting, steam engines, turbines and other equipment. Albany Grease Co., Division of Adam Cook's Sons, Inc.

72 **Force Feed Lubrication**—Catalog 25-C describes in detail model "25" force feed lubricator providing positive and automatic lubrication of cylinders and bearings. Delivers oil where and when it is needed in the right quantity and without guesswork or uncertainty. Manzel Brothers Co.

73 **Electric Vibrators**—Folder shows typical installations of electric vibrators for keeping materials flowing freely through hoppers, chutes, increasing weight contents, and eliminating air pockets. Syntron Co.

74 **Packings** — Sixty-four pp. catalog illustrates and describes a comprehensive line of packings, gaskets, gasket and lubricating pastes, etc. Reference to text and recommendation tables will enable you to select a satisfactory material for any packing job. The Garlock Packing Co.

75 **Welding Applications**—Vest pocket data for cutting costs, speeding work, improving quality, increasing profits by arc welding, has 40 pp., on some 23 typical arc welding applications. Hobart Brothers Co.

76 **Lubrication** — An 8-pp. bulletin illustrated in three colors describes in detail the Farval centralized system of lubrication and its component parts. Cross-sections show the progressive movements within Dualine measuring valve as it delivers oil or grease under pressure to each individual bearing. Farval Corp.

77 **Insulating Materials For High Temperature Service**—Interesting new bulletin describes Unibestos heat insulation suitable for blocks, sheets and sectional pipe covering highly resistant to moisture damage and is easy to remove and reapply without breakage. One interesting feature of this bulletin is table which gives all data needed for figuring the average insulating job. Union Asbestos & Rubber Co.

78 **Humidifiers** — Armstrong steam type humidifiers are described in an 8-pp. bulletin which explains why steam is an excellent humidifying medium during the winter heating season. Contains many useful tables and diagrams of practical value to every engineer who has a winter-time humidification problem. Armstrong Machine Works.

FIG. 1501 (*RIGHT*)
CAST STEEL GATE VALVE

•

FIG. 1511 (*BOTTOM*)
CAST STEEL GLOBE VALVE

•

FIG. 1515 (*LEFT*)
CAST STEEL ANGLE VALVE

•

FIG. 1531 (*TOP*)
CAST STEEL CHECK VALVE

READING-PRATT & CADY Helps You Standardize on 150 lb. Steel Valves

When you need valves or fittings for such services as low pressure boiler feed water and steam lines for exhaust steam; and for such auxiliary lines as injector pumps, fans, soot blowers, condensers, heat exchangers, etc., do not fail to get READING-PRATT & CADY'S recommendations.... Our extensive line of 150# Cast Steel Valves and Fittings help you standardize on Steel for 150 lb. Service where conditions such as high temperature make it impractical to use other types of valves. ... Although the valves and fittings illustrated are flanged end, all are available with welding end and most with screwed end. ....

READING-PRATT & CADY
READING, PENNSYLVANIA

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VALVES & FITTINGS

PRATT & CADY
BRASS & IRON VALVES

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ENGINEERING
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A Division of AMERICAN CHAIN & CABLE COMPANY, INC.

TODAY You Need the FASTEST TUBE CLEANERS

Down time for cleaning tubular equipment is awfully expensive right now. You need the fastest and most dependable cleaners money can buy, especially since the entire cost of such cleaners is insignificant compared with the value of the equipment tied up.

Now, more than ever, the exclusive time and labor saving features of the new Roto Tube Cleaner will pay you a handsome return on your investment. The powerful new Roto cleans out scale faster than ever before possible. The exclusive air valve on the motor enables the operator to work entirely by himself, saving the cost of a helper and eliminating starting and stopping delays between every tube cleaned. High quality alloys and precision construction make the new Roto the most economical for upkeep of any cleaner we ever made.

Just compare the new Roto with any other cleaner in your plant.

SEE OUR ADV. IN SWEET'S AND WRITE

The ROTO Company
145 SUSSEX AVENUE
NEWARK, N. J.

ROTO TUBE CLEANERS

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

(Continued from Page 122)

At the recent Atlanta meeting of Illuminating Engineering Soc., Arthur A. Brainerd and Matt Denning gave results of their 2-yr. investigation into Improved Vision in Machine Tool Operation by Color Contrast. In tests of light colors under incandescent and mercury lighting, light buff and light gray showed highest scores in psychological effect accident hazard reduction and increasing production. Aluminum showed high and light blue promising.

As a practical compromise, painting machines horizon gray and spotlighting the working area with light buff seemed to show better results than solid colors. Further tests are under way by Mr. Denning who is director of trade sales of Finishes Division of the Du Pont Co.

Heads Illinois Tech's Electric Department

Dr. Jesse E. Hobson, Westinghouse's former power system expert, was recently named director of the Electrical Engineering Department of Illinois Institute of Technology at Chicago. Dr. Hobson will teach senior and graduate student courses in power system engineering as well as organize and direct electrical engineering courses.

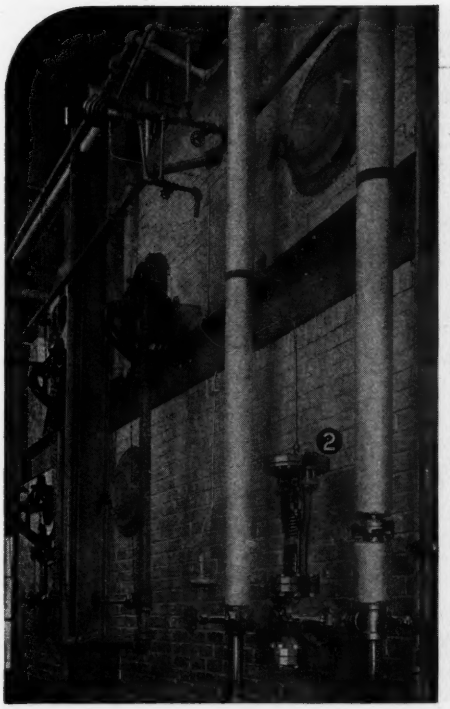
Dr. Hobson was born in Indiana 30 yr. ago, graduated from Purdue University in 1932. He obtained his Master's degree at Purdue and went to California Institute of Technology, on a Chas. A. Coffin Foundation Fellowship, and was awarded his doctor's degree there. He joined the Westinghouse Co. in 1937 after teaching experience at the California Institute of Technology, Earlham College and Armour Institute of Technology.

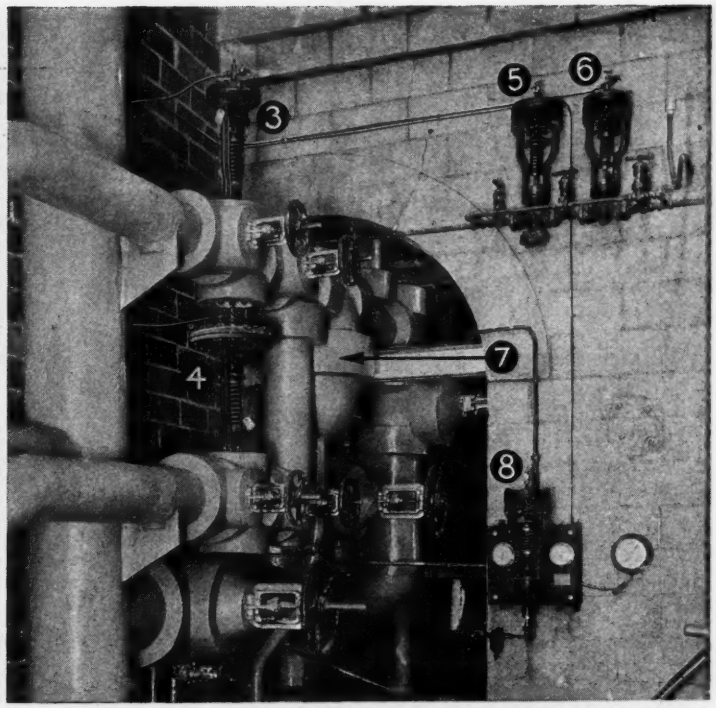
New N. A. C. A. Chairman

Dr. Jerome C. Hunsaker was recently elected Chairman of the National Advisory Committee for Aeronautics as successor to Dr. Vannevar Bush. Dr. Bush who is also president of the Carnegie Institution of Washington, resigned as N.A.C.A. chairman following his appointment by President Roosevelt as Director of the newly created office of Scientific Research and Development.

The President also appointed Dr. Wm. F. Durand as a member of the committee to succeed Dr. Robert E. Doherty. Dr. Doherty is president of the Carnegie Institute of Technology at Pittsburgh and recently resigned from the N.A.C.A. because of pressure of other duties. Dr. Durand, one of the original members of the committee appointed by President Wilson in 1915, retired from the committee in 1933. He is professor emeritus of mechanical engineering at Leland Stanford University, a recognized authority on aeronautical research and a noted consulting engineer.

Dr. Hunsaker, the new N.A.C.A. Chairman, graduated from the Naval Academy in 1908, received his Master's and Doctor's degree from M.I.T. in 1912 and 1916 respectively. He has had long experience in aeronautics, is an international recognized authority on aeronautical science. He has been head of the Department of Mechanical Engineering at M.I.T. since 1933.

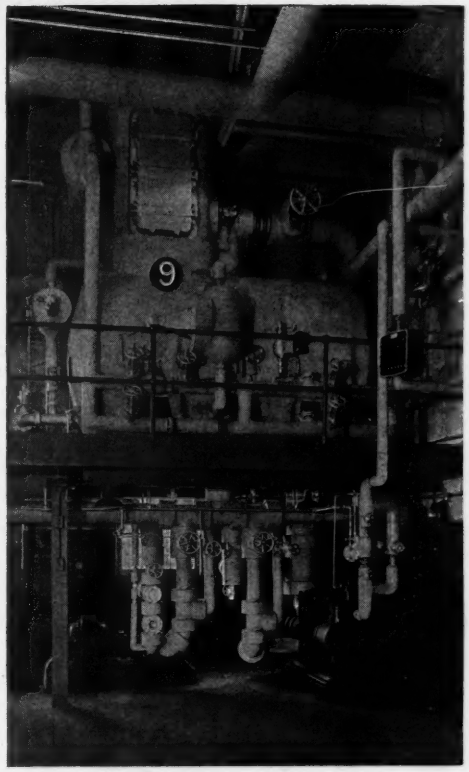




For protection of your costly machinery and assurance against time loss . . . install "ALL-SWARTWOUT" Controls

Swartwout Controls help you keep profitable power service flowing with safety, efficiency and economy. Several of the most widely known Swartwout Controls are shown here at work in American power plants. . .

[1] and [2], Generator and Control Valve of Swartwout "S-C" Feed Water Regulating System • [3] and [4], Swartwout Steam Pressure Reducing Valves • [5] and [6], Swartwout Valves controlling admission of water to [7], Swartwout Carburetor Type Desuperheater • [8], Swartwout Master Regulator controlling steam pressure valves • [9], Swartwout Deaerating Feed Water Heater.



And for additional services in the power plant hookup, Swartwout supplies ***Steam Separators, Liquid Level Controls, Pump Controls*** and other equipment.

Swartwout lends assistance in determining control hookups with unusual safety features that keep your plant running with the least worry and maintenance expense. Proposals gladly submitted after discussion of your problems.

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

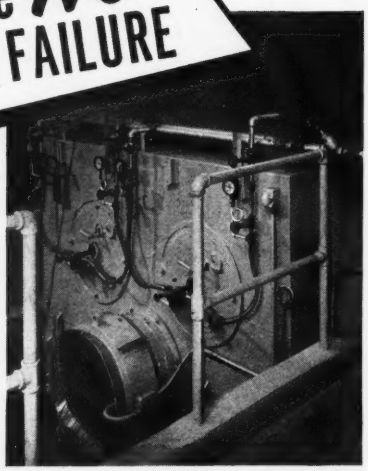
•Power Plant Equipment•

THE SWARTWOUT COMPANY
18541 Euclid Avenue • Cleveland, Ohio

* * *

Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

...There must be NO MECHANICAL FAILURE



PRESENT demands require, more than ever, that a boiler STAY "on the line" for long, uninterrupted periods. Where oil fuel is used, this calls for absolute dependability on the part of the oil burning equipment . . . there must be no mechanical failure.

The success of Enco Oil Burning installation lies in the proper coordination of the many details involved — efficient burners properly selected and applied— dependable Oil Pumping and Heating Equipment provided with all automatic controls for delivering the fuel oil at the correct temperature and pressure, together with all safety devices against improper operation.

We will be glad to send you Bulletins OB-40 and 37 describing ENCO Oil Burning, Pumping and Heating Equipment.

THE ENGINEER COMPANY

75 WEST STREET (Enco) NEW YORK, N.Y.

SAVE CHROMIUM

HELP NATIONAL DEFENSE

You can save chromium for defense and save money in your own plant by using our Chrom Glucosate. You are wasting chromium, badly needed in our National Defense program, when you use it for corrosion control instead of chrom glucosate.

Look at this table of comparison. It tells a commanding story.

COMPARATIVE CHROMIUM CONSUMPTION USING GLUCOSATES AS COMPARED TO CHROMATES

Amt. in form of Glucosate	Amt. as dichromate	Application	Saving
SODIUM BICHROMATE			
17 pounds	100 pounds	Calcium Brine	83 lbs.
17 pounds	200 pounds	Salt Brine	183 lbs.
34 pounds	500 pounds	Cooling Water	466 lbs.
CHROMIC ACID			
3 pounds	66 pounds	Calcium Brine	63 lbs.
3 pounds	132 pounds	Salt Brine	129 lbs.
10 pounds	330 pounds	Cooling Water	320 lbs.

Furthermore, there are other glucosates that eliminate the need of chromium. Let us send you the whole story.

Help us to stop the waste of chromium ore. Switch to Chrom Glucosate at once and tell your business acquaintances the story of Chrom Glucosate too.

WATER CONSULTANTS

D. W. HAERING & CO., INC.

GENERAL OFFICES: 205 West Wacker Drive

CHICAGO, ILLINOIS

Magnesium for Defense

MAGNESIUM METAL, about one-third lighter than aluminum but of about the same strength, will be produced in an $8,000,000 magnesium refinery now being built at Permanente, near Los Altos, Cal. by the Chemical Engineering Division of the Todd-California Shipbuilding Corporation, headed by Henry J. Kaiser.

Magnesium will be refined from magnesite ore from Nevada using an electrothermic reduction process developed by Dr. F. J. Hansgirg. Power which will be purchased from the Pacific Gas & Elec. Co. will approximate a demand of 75,000 kw. In the reduction process magnesite ore is heated from 1850 to 2200 deg. F. in a gas-fired kiln so as to produce magnesium oxide. The oxide is finely ground, mixed with powdered carbon and formed into briquets with pitch as a binder. Briquets are fed into an electric furnace operating at about 3650 deg. F. they are converted into magnesium vapor and carbon monoxide.

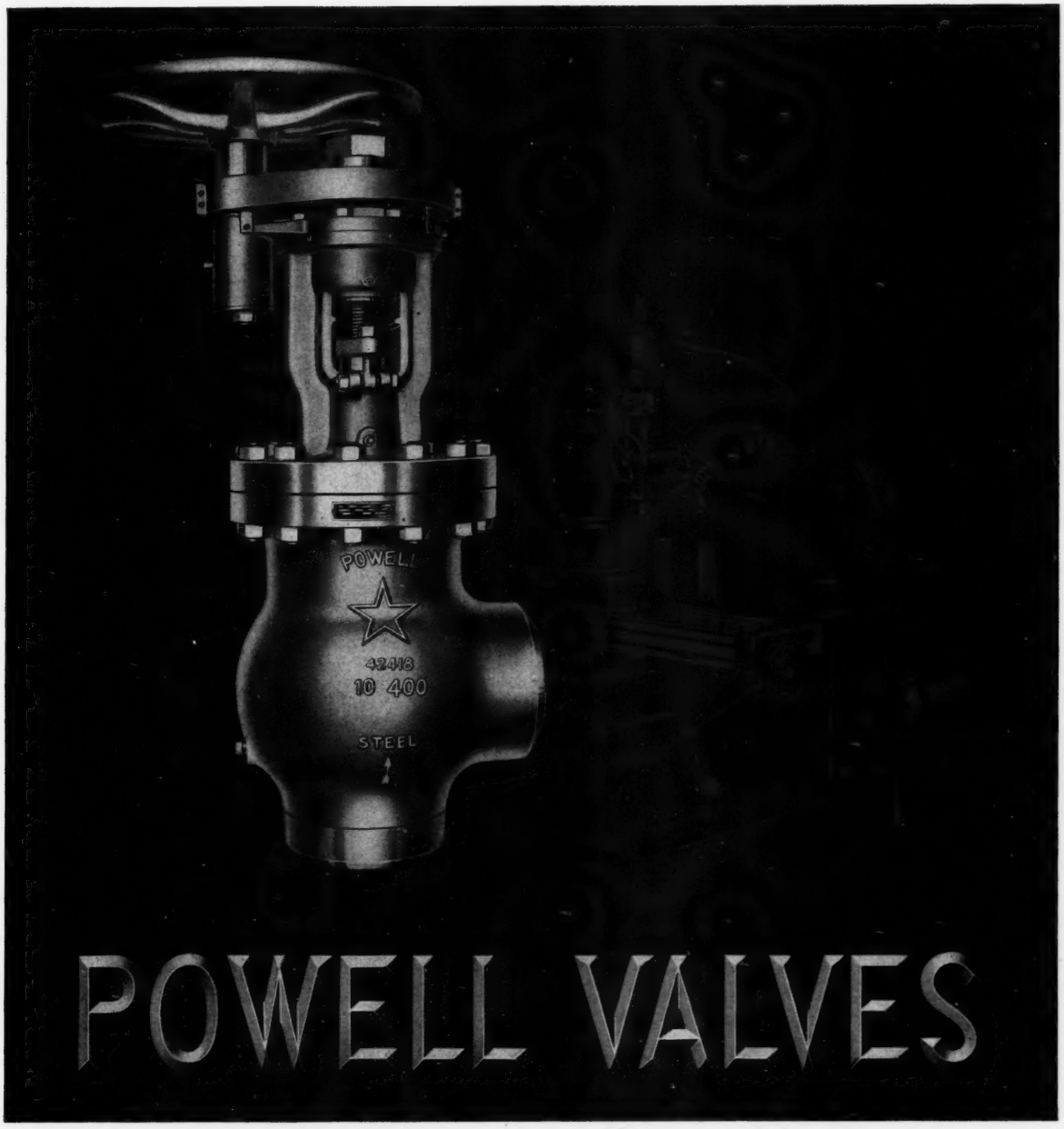
The temperature is then speedily reduced to 400 deg. by large quantities of cold natural gas. Magnesium vapor becomes a fine powder which is accumulated in storage bins and compressed into tablets. This magnesium is again vaporized in an electric retort heated to 1400 deg., cleaned of carbon and other substances. The vapor crystalizes in rings in the upper walls. These rings are magnesium metal 99.97 per cent pure.

Although the plant is being built primarily as a defense project, the company foresees a great market for magnesium metal for all types of construction, railroads, automobiles, portable tools, etc., where lightness and strength are desired. Articles made of magnesium metal will have about the same strength as steel but only one-fourth the weight.

Defense Training

ENGINEERING DEFENSE TRAINING has been extended by appropriation of $17,500,000 on July 1, 1941, in addition to the $9,000,000 allocated in October, 1940. Already 2300 courses have been set up in 144 engineering colleges for 130,000 students. No tuition fee is charged to persons with necessary educational qualifications who are employed or employable in defense work. These are short intensive courses of college grade covering Engineering, Science and Management. Present facilities will be extended so that 90 per cent of the Engineering colleges will offer instruction. Application should be made to an institution giving a desired course, information being available from U. S. Office of Education, Washington, D. C.

New members of the advisory committee are Homer L. Dodge, Univ. of Oklahoma on training of physicists; Clare E. Griffin, Univ. of Michigan on production supervisors; N. W. Rakestraw, Brown Univ. on training of chemists. Members previously serving are Andrey A. Potter, Purdue Univ., chairman; F. L. Bishop, Soc. Prom. Eng'g. Education; R. E. Doherty, Carnegie Inst. Tech.; Gibb Gelchrist, Texas A. & M.; H. P. Hammond, Penn. State College; W. O. Hotchkiss, Rensselaer Poly Inst.; R. S. McBride, Cons. Engr.; Thorndike Saville, N. Y. Univ.; C. C. Williams, Lehigh Univ.; B. M. Woods, Univ. of Calif.; Allen M. Horton, Jr., U. S. Office of Education, sec'y.



PRECISION. . .

Powell Valves are designed from the beginning to perform specific functions in the ever-changing American Industrial picture. They are checked and tested for design, material and performance by skillful, experienced research engineers on the most up-to-date laboratory equipment to be had. When these preliminary steps are completed and production starts the latest type machines are necessary to insure the strictest adherence to the standards of precision set up by Powell engineers.

The valve shown here is a 10″ class 400 lb. non-return Angle Valve especially designed for modern power plant usage. It is made of Carbon Molybdenum Alloy Steel with Stellite faced seats and discs. Pipe ends are engineered for welding. Here is a fine example of a valve, made-to-order for a special job with traditional Powell perfection.

The Wm. Powell Company
Cincinnati, Ohio

ONE of the best ways to be sure that unit heaters, pipe coils, water heaters, etc. do not waste fuel is to see that they are drained with Nicholson Industrial Steam Traps. Among the Nicholson Trap features which insure better drainage are:

NO AIR-BINDING—All four types discharge air just as efficiently as water.

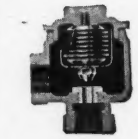
NO FREEZE-UPS—Types A, AU and C drain completely when cold, hence cannot freeze.

NO ADJUSTMENT—Same adjustment used for any pressure from vacuum up to the maximum allowable with construction used.

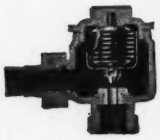
NO DRIBBLING—Traps close immediately when steam contacts bellows.

NO WATER-LOGGED UNITS—Require but a few degrees temperature differential between steam and condensate to open valve. Write for Steam Trap Catalog No. 941.

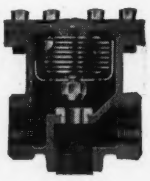
OTHER NICHOLSON PRODUCTS—Piston and weight operated steam traps, compressed air traps, gasoline traps, steel and stainless steel floats, flexible couplings, 3 and 4-way valves, compression shaft couplings, steam eliminators and separators, expanding mandrels, arbor presses.



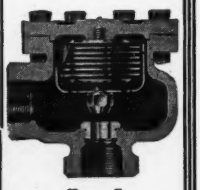
Type A



Type AU



Type B



Type C

W. H. NICHOLSON & CO.
160 Oregon St. Wilkes-Barre, Pa.

Simplex Type MS

YOU need never guess about the tabulation of Boiler Feed, Turbine Condensate, Steam, Air or other fluids when you have a Simplex Meter on the job.

Although low in first cost and maintenance, and designed for use with orifices, nozzles or venturis — sturdy Simplex Meters provide an accurate summary of fluid flows that pave the way to high savings in plant operation.

There is a Simplex instrument for your specific problems. Let our engineers show you how the proper selection of your metering equipment can insure greater plant efficiencies.

Write for descriptive Bulletin No. 52.

SIMPLEX VALVE & METER CO., 6790 Upland St., Philadelphia, Pa.

SIMPLEX METERS

Wisconsin Power Co. to Expand

THE WISCONSIN Power & Light Co., Madison, Wis., has plans under way for extensions in steam-electric generating station at Beloit, including construction of new addition and installation of turbine-generator unit, high-pressure boilers and auxiliary equipment. Large increased capacity will be carried out. Project will be carried out as part of a general expansion program in that area, to include new power substations, extensions in present substation units, transmission and distributing lines, and other operating facilities. Entire development will require a period of about 36 mo. for completion, and is estimated to cost approximately $4,000,000.

New Magnesium Mill at Austin, Texas

THE INTERNATIONAL Agricultural Corporation, 61 Broadway, New York, affiliated with Union Potash & Chemical Co., Inc., same address, has concluded agreement with Government for construction and operation of a new plant for the production of metallic magnesium. A tract of land is being acquired in vicinity of Austin, Tex., as site for mill, which will consist of a large group of one and multi-story production units, equipped for an initial output of about 24,000,000 lb. of finished material per annum. A boiler house, machine shop and other mechanical buildings will be erected. Power supply will be secured from hydroelectric power development of Lower Colorado River Authority, Austin, with transmission line to be constructed to plant site, where new power substation will be built. Company will also develop dolomite ore properties in immediate district for raw material supply, and will build a concentrating mill for this branch of operations. Entire project is reported to cost about $12,317,000, and fund in that amount will be secured through Defense Plant Corporation, Washington, D. C., a Federal agency, which will hold title to plant. Of this amount, approximately $9,100,000 will be used for the magnesium plant; $1,500,000 for purchase of site, power lines, substation and other facilities; and remainder for ore mill. Work is scheduled to begin at early date, with completion late in 1942.

Pacific Gas to Expand

THE PACIFIC GAS & ELECTRIC CO., San Francisco, Calif., is completing plans for expansion in steam-electric generating station near Bakersfield, Calif., known as Midway plant, to include installation of a new 60,000-kw. turbine-generating unit, to increase station capacity to 85,000-kw.; also, two 1500-hp. high-pressure boilers, to have a rating of 450,000 lb. of steam per hour, and complete auxiliaries. Switchyard will be enlarged, and new transformers, high-tension switching apparatus and accessories installed. Entire project is estimated to cost about $7,480,000 and will be carried out over a period of months.

Company also plans construction of a new transmission line from Midway generating station noted to San Luis Obispo, Calif., about 60 mi., where power substation will be increased with installation of a new 10,000-kw. synchronous condenser and auxiliary equipment. Cost estimated at $727,600, in addition to amount previously noted.

BOILERS *can Loaf, too*

A steam boiler, like a man, has a greater capacity for work than is usually derived from it. Similarly, its value rises with any new output gained.

A boiler's work is to burn fuel and circulate water, turning as much as possible of the heat of the fuel into steam. This work is slowed down proportionately as the boiler collects scale.

There are many ways to raise the efficiency of a boiler; the best is to stop any scale before it even starts to form.

That is Bird-Archer's way . . . scientific treatment of the boiler water . . . through which thousands of companies now get far greater value from their boiler investment in terms of useful work.

Have you a copy of this useful handbook on types of water, situations, treatments? We'll be glad to send you one—without cost, of course. Simply write for "Boiler Water Treatment."

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Scientific Boiler Water Treatments
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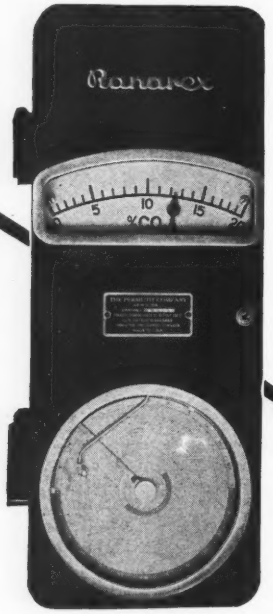
SIMPLEST GUIDE TO EFFICIENT FIRING—



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CO_2 INDICATOR and RECORDER

★ ACCURATE — within 3/10 of 1%.

★ FAST — CO_2 stack readings in 30 seconds.

★ TOUGH — no chemicals or fragile parts.

★ ECONOMICAL — cuts fuel waste as much as 20%.

Free booklet gives complete details. Address: The Permutit Company, Dept. A1,330 West 42nd Street, New York, N. Y. *Trademark Reg. U. S. Pat. Off.

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PERMUTIT

New Hydroelectric Power Plant for Iowa

THE First Iowa Hydro-Electric Cooperative, Inc., 210 Walnut Building, Muscatine, Iowa, Harry J. Strong, manager, has plans under way for a hydroelectric power project on the Cedar River, near Moscow, vicinity of Muscatine. A power dam will be constructed at that point, to form a reservoir of about 11,000 acres of land. Project will include transmission lines, power substations and auxiliary structures, and is estimated to cost about $13,500,000. Application for permission to proceed with project has been made to the Federal Power Commission, and it is understood that financing will be carried out through Federal aid. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

Philadelphia Rate Reduction

H. P. LIVERSIDGE, president, put into effect Sept. 1 the largest single electric rate reduction in the history of the Philadelphia Electric Co. This will amount to $4,000,000 annually and was recently ordered by the Pennsylvania Public Utility Commission. In making formal announcement of the reduction, Mr. Liversidge pointed to the fact that electric rates have been definitely lowered in every year, with a single exception, since 1928. These reductions, including the one effective Sept. 1, represent total annual savings to customers of more than $20,000,000.

All classes of electric customers are benefited by the new schedules: residence customers saving in excess of $1,250,000; smaller commercial and industrial users about $1,970,000; and, larger commercial and industrial customers slightly more than $635,000 annually. Savings will also accrue to the city and federal governments and to various municipalities in the company's service area.

As of May, 1941, the company had 415,613 residence customers in the city of Philadelphia and 177,673 in its suburban area. The total number of customers served in all classifications is in excess of 742,000.

Potomac Electric Power Expansion

THE Potomac Electric Power Co., Washington, D. C., is arranging an expansion and improvement program at plants and properties to cost $20.000,000 during 1942 and 1943, and which, with expenditures totaling $10,000,000 during 1941, will make a gross of $30,000,000 in this 3-yr. period. A considerable part of the fund will be used for extensions in Buzzard Point steam-electric generating station, where capacity will be increased by 150,000-kw. during the 36 mo. noted.

A 50,000-kw. turbine-generator unit recently has been installed at this plant, and three more units of this same rating have been ordered. One of these will be installed in the spring of 1942, and the other two during the spring and winter of 1943, including additional high-pressure boilers and auxiliary equipment. The total cost of this plant expansion is estimated at $11,395,000. The program will include extensions in transmission and distributing lines, power substations and other structures and facilities.

Why the EVERLASTING FLATPLUG Valve *is ideal for many throttling services*

Angle Type Everlasting Flatplug Valve

1. LASTINGLY TIGHT
Remains dependably tight through long years of service and frequent operation.

2. TIME-SAVING
Provides quick opening and quick closing with a quarter turn of the handle.

3. WITHSTANDS ABUSE
The faces cannot be jammed by the operator; cannot be shut too tight.

4. ADAPTABILITY
Suitable for use with air, gasoline, oils, syrups, steam, water, and other fluids.

5. EASILY REPAIRED
Valve Seat lifted out with the fingers; renewal of all working parts can be made in 5 minutes.

Made in straightline and angle types with iron body or special metals in all sizes from ½-in. to 4-in. for pressures up to 175 lb.

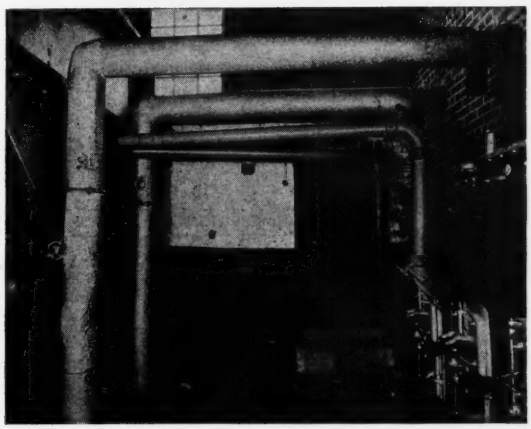
Write for Complete Information

Everlasting Valve Company
Jersey City, N. J.

Everlasting Valves
for everlasting protection

39% ANNUAL RETURN ON INVESTMENT

Earned by IRON FIREMAN Pneumatic Spreaders in Nicetown Dye Works



7 Important Benefits

Here is the record of two Iron Fireman Pneumatic Spreaders which replaced stokers of another type in the power plant of the Nicetown Dye Works Co. in Philadelphia.

1 Fuel cost per 1000 pounds of steam dropped from 34 to 25 cents—a saving of 26.4%.

2 Coal consumption during nine-hour banking period was cut from 5,000 to 500 pounds—saving 4,500 pounds daily.

3 Cost of power for operating stokers declined 65%.

4 Boiler room labor was reduced substantially.

5 Maintenance costs were drastically cut.

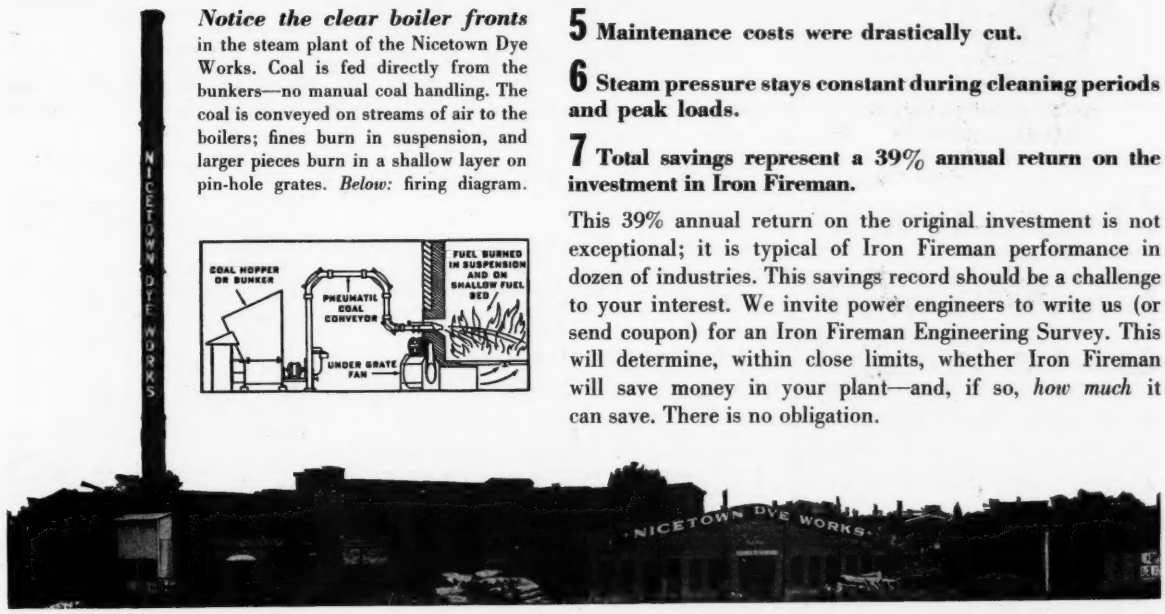
6 Steam pressure stays constant during cleaning periods and peak loads.

7 Total savings represent a 39% annual return on the investment in Iron Fireman.

This 39% annual return on the original investment is not exceptional; it is typical of Iron Fireman performance in dozen of industries. This savings record should be a challenge to your interest. We invite power engineers to write us (or send coupon) for an Iron Fireman Engineering Survey. This will determine, within close limits, whether Iron Fireman will save money in your plant—and, if so, *how much* it can save. There is no obligation.

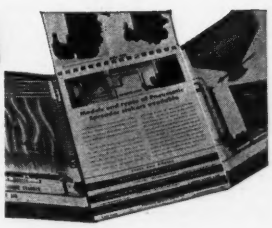
NICETOWN DYE WORKS
COAL HOPPER OR BUNKER
PNEUMATIC COAL CONVEYOR
FUEL BURNED IN SUSPENSION AND ON SHALLOW FUEL BED
UNDER GRATE FAN

Notice the clear boiler fronts in the steam plant of the Nicetown Dye Works. Coal is fed directly from the bunkers—no manual coal handling. The coal is conveyed on streams of air to the boilers; fines burn in suspension, and larger pieces burn in a shallow layer on pin-hole grates. *Below:* firing diagram.



IRON FIREMAN

Automatic Coal Stokers



SEND FOR FREE NEW PORTFOLIO

Mail coupon, without obligation, for free copy of new Iron Fireman Pneumatic Spreader portfolio. Simple diagrams of stokers, blueprints and operating data of typical installations.
IRON FIREMAN MFG. CO. (Portland, Ore., Cleveland, Toronto.)
Mail to 3024 West 106th St., Cleveland, Ohio.

☐ Send, Free, new Pneumatic Spreader Portfolio.
☐ See us about making, without obligation, an Iron Fireman Engineering Survey.

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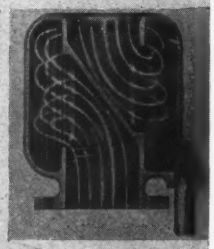
In more than
12,000 Plants
COCHRANE
MULTIPORT
RELIEF VALVE

Cochrane Multiport Back Pressure Relief Valve with front and back plates removed.

Successful operation of the Cochrane Multiport Valve in more than 12,000 plants is a sure guarantee of its continuously reliable operation. This continuous operation is insured by the multiport principle — a number of small discs instead of one large disc, eliminating the sticking, jamming and freezing common to single-disc valves in the control of atmospheric relief, back pressure, etc.

Call your Cochrane representative or write for further details.

COCHRANE Exhaust Head



Designed to separate condensate and oil from steam discharged to atmosphere and thereby prevent raining of water and oily condensate on the roof, Cochrane Exhaust Heads incorporate a highly efficient free-flowing baffle type construction and an exceptionally large port area which minimizes back pressure. Write for further details.

COCHRANE CORPORATION

COCHRANE

Cochrane Corp., 3123 N. 17th St., Phila., Pa.
Please send me complete information on Cochrane Multiport Relief Valve and Cochrane Exhaust Head.
Name_____
Firm_____
Address_____
City_____ State_____

TVA Awards Contracts

TENNESSEE VALLEY AUTHORITY, Knoxville, Tenn., has awarded contracts for generating equipment for several hydroelectric power stations, with total cost aggregating over $11,115,000, as follows:

To the Allis-Chalmers Mfg. Co., Milwaukee, Wis., for two electric generators for Wilson Dam, Ala., power plant, at $727,813, and for two hydraulic turbines and governors for same installation, at $424,200; these will be known as Units Nos. 13 and 14. Also, an award to the same company for five hydraulic turbines and governors for new Kentucky Dam project at Gilbertsville, Ky., on Tennessee River, about 26 mi. from Paducah, Ky., at $3,362,400.

The five electric generators for the last project will be furnished by General Electric Co., Schenectady, N. Y., at a contract price of $2,652,319. Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa., has received an award at $627,115 for two electric generators and accessories for Appalachia power dam project; hydraulic turbines, governors and butterfly valves for this last noted development will be furnished by Baldwin-Southwark Div., Baldwin Locomotive Works, Eddystone, Pa., at contract price of $757,820.

This latter company has also secured an award for two hydraulic turbines and governors for the Watts Bar Dam generating station, at $1,095,076; and the two electric generators for this installation will be furnished by the Westinghouse Company at $958,490. The last noted company also has contract for an electric generator unit for Ocoee No. 3 power project, on Ocoee River; hydraulic turbine and butterfly valve will be supplied by S. Morgan Smith Co., York, Pa., at $217,675; and the governor unit, by Woodward Governor Co., Rockford, Ill., at $28,495.

High Voltage Equipment

ONE OF the most comprehensive surge test apparatus for testing the effects of lightning on all kinds of electrical equipment was recently sold to Northwestern University for use in their new $5,000,000 Technological Institute at Evanston, Ill.

The lightning-making equipment, a 1,500,000 v. surge generator and a 500,000 volt-ampere, 60 cy. high voltage test set —will be built and installed by the Westinghouse whose engineers collaborated with Dean O. M. Eshgach, in planning the laboratory. These high voltage installations will help make the engineering school one of the best equipped in the United States.

The lightning laboratory will be used in the instruction of students, for insulation research with facilities available to public utilities in the Chicago area. Doors that will act as safety switches are among the elaborate protective devices to be installed in the laboratory for the safety of students or others who might enter the high voltage room. The doors will be so interlocked with the equipment that, should a person accidentally open one and wander into the room, the high voltage circuits would be opened immediately. In addition to the regular control desk, a small portable control unit about the size of a serving tray and as easily carried will operate the high power devices from any spot in the laboratory.

ENGINEERS... ATTENTION!

NOW IS THE TIME
TO ORDER REPLACEMENTS
ERNST
PRECISION GAGE GLASSES
for high pressure and temperature and
ALL SIZES
FLAT GAGE GLASSES
— CLEAR AND REFLEX —
Nonhardening and Nonsoftening
GAGE GLASS GASKETS
that will fit exactly

THEY WILL NOT BLOW OUT

STANDARD high pressure—square cut—STEAM GASKETS—over 100 different sizes.

LIP-MOLD pattern
Expansion type GASKETS

SPECIAL OIL RESISTANT GASKETS
Send for Gage Glass and Gasket Chart
ERNST WATER COLUMN & GAGE CO.
RUBBER & GLASS DIVISION
LIVINGSTON, N. J.

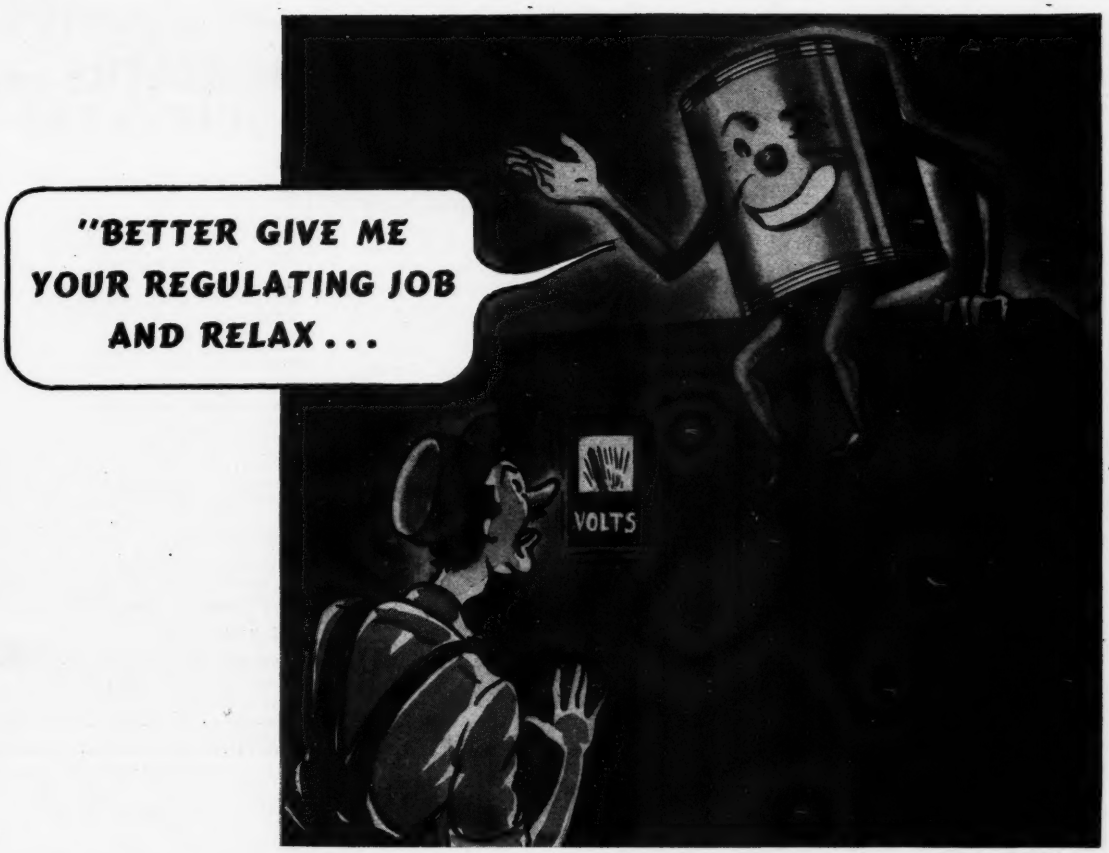
SAUERMAN
Power Scrapers

★ **The problem of storing coal safely and economically has been solved permanently at hundreds of steam generating plants, both large and small, by installing Sauerman Power Scrapers.**

A Sauerman scraper unit has no equal for simplicity of installation and operation, nor does any other method of storing and reclaiming carry as positive an assurance of building a coal-pile that will be free from the chance of spontaneous combustion.

Write for Catalog.

SAUERMAN BROS., INC.
486 S. Clinton St., CHICAGO



I Keep Generator Voltage Steady!"

HERE'S the modern way to assure smooth, steady generator voltage at all times—with G-E DIACTOR regulators. Their accurate, *automatic* operation squashes voltage bumps almost before they start.

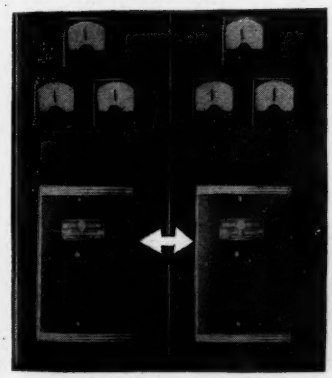
Voltmeters quiet down and voltage worries end when a wide-range DIACTOR regulator goes on the job. This compact little fellow holds the voltage close to the desired value quite simply; after a change in operating conditions, he quickly returns the voltage to normal without hunting or instability. And because of the simple, reliable design (all parts are normally stationary), you needn't worry about bothersome, costly maintenance, or continual re-adjusting.

Here are some of the more important features of these regulators:

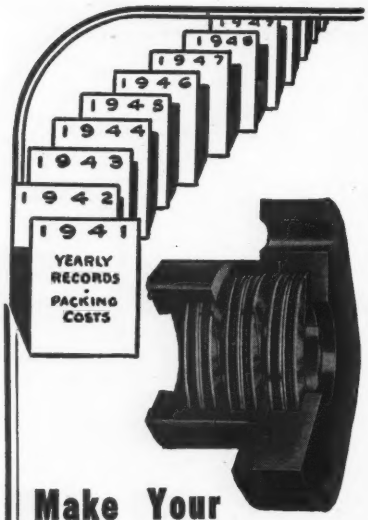
Direct acting—fast in operation
Electrically damped—no dashpots
No vibrating contacts—for reliability and long life
Simple construction—only six leads required
Low in price—starting at $70 list

Whether your problem is one of replacing old regulating equipment, or involves a completely new installation, there's a DIACTOR generator-voltage regulator exactly suited to your needs. A specialist in the nearest G-E office will be glad to give you complete information. General Electric, Schenectady, N. Y.

Streamlined DIACTOR regulators are well adapted to semi-flush mounting on your switchboard panel.



GENERAL ELECTRIC



Make Your Next Packing Job

L-A-S-T!

During these days of increased production, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency. And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C.

Sold on approval Satisfaction Guaranteed

Write for details and Catalog M-5. Make your next packing job L-A-S-T!

THE FRANCE PACKING COMPANY

Tacony Philadelphia Penna.

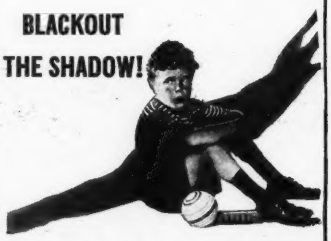
Branch Offices in Principal Cities

Original **FRANCE METAL PACKING**

Cold Room

ONE OF THE coldest rooms in existence was recently installed for testing purposes in the new $6,735,000 Technological Institute of the Northwestern University at Evanston, Illinois. In this low temperature research building is a compartment large enough to house an automobile, and the temperature therein may be carried to 75 deg. below zero, believed to be the lowest cold ever created for full-scale research. Readings are taken from a dynamometer mounted outside the room to compute the effect of cold on the operation of engines of any kind. Observers will sit outside in the normal Evanston climate looking through observation windows.

BLACKOUT THE SHADOW!



CLOSE to all of us is the threatening spectre of tuberculosis. No respecter of persons, it lurks in every corner, may strike at any moment. *More people between 15 and 45 die from tuberculosis than from any other disease.*

Yet tuberculosis *can* be driven from the face of the earth. Since 1907 your Local Tuberculosis Association has helped reduce the toll of tuberculosis by 75%!

By buying Christmas Seals you will help us complete the job—and make this a safer world for yourself and your loved ones.

Buy CHRISTMAS SEALS

Inspectors of aeronautical engineering materials are desired by the Navy Dept., especially junior inspectors who have completed acceptable defense training courses in tool engineering, gaging and inspection methods, instrument design and related subjects. In this grade, salary is $1620 a year. Higher grades pay up to $2600, maximum age limit being 65 yr. For these higher grades, experience is required in inspection or testing of materials to determine compliance with specifications or standards of manufacture. Study in engineering or metallurgical courses is accepted as partial experience. For engines, mechanical parts, instruments, tools and gages, and materials, experience on aircraft work is not required; such experience is essential for work on aircraft, propellers and parachutes. Application may be filed with and further information obtained from the Commission's representative at any 1st or 2nd class post office, or from the Civil Service Commission office, Washington, D. C.

DESIGNERS and CHECKERS

Experienced in any one or more of the following:

INDUSTRIAL POWER PLANT
Plant layout, piping, etc.

CONCRETE & STRUCTURAL STEEL
General Steel Mill Buildings, intricate reinforced concrete structures such as machinery and building foundations, steel and concrete trestles, etc.

MECHANICAL
General Steel Plant Piping for water, steam and air systems for rolling mills, power house, pumping stations, etc.

ELECTRICAL
Draftsmen for general power plant such as overhead and underground distribution systems, switchboard, lighting, etc.

IN REPLYING
State fully your qualifications, past experience in complete detail, salary, age and date available.

ARTHUR G. McKEE & COMPANY
CLEVELAND, OHIO
ATTENTION—R. E. DUFF

Opportunities Offered

PURCHASING AGENT. Experienced with mechanical engineering training, to take complete charge in defense corporation. Must be entirely familiar with priorities. Good salary. Give full details upon application. Address Box 1220, POWER PLANT ENGINEERING, 53 West Jackson Blvd., Chicago, Ill.

Help Wanted

WANTED—Turbine and Switchboard Operator for Industrial Plant located in the South. Must be experienced in operation of General Electric extraction type turbines, switchboard and auxiliary equipment. In replying give full details. Address—Box No. 1219, c/o POWER PLANT ENGINEERING, 53 West Jackson Blvd., Chicago, Ill.

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

Boys help operate this plant

—*and they get high efficiency with Hagan Automatic Combustion Control*

HOW to operate efficiently with unskilled help is no problem in this power plant of a Pennsylvania industrial school for boys.

The plant was designed to operate with a staff consisting largely of youthful inmates of the institution. With no outside source of power, the equipment *had* to be dependable, capable of steady operation with little or no attention.

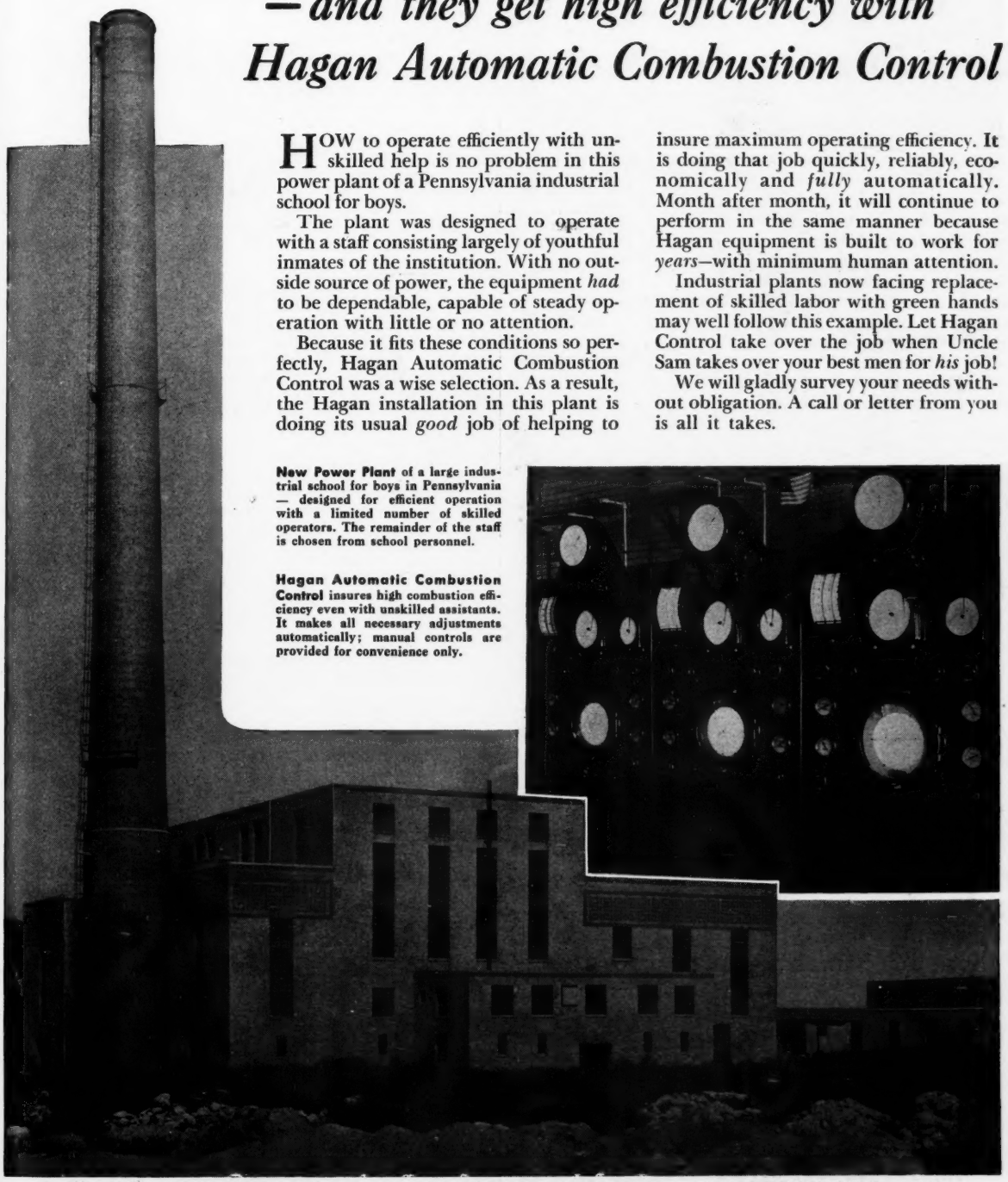
Because it fits these conditions so perfectly, Hagan Automatic Combustion Control was a wise selection. As a result, the Hagan installation in this plant is doing its usual *good* job of helping to insure maximum operating efficiency. It is doing that job quickly, reliably, economically and *fully* automatically. Month after month, it will continue to perform in the same manner because Hagan equipment is built to work for *years*—with minimum human attention.

Industrial plants now facing replacement of skilled labor with green hands may well follow this example. Let Hagan Control take over the job when Uncle Sam takes over your best men for *his* job!

We will gladly survey your needs without obligation. A call or letter from you is all it takes.

New Power Plant of a large industrial school for boys in Pennsylvania — designed for efficient operation with a limited number of skilled operators. The remainder of the staff is chosen from school personnel.

Hagan Automatic Combustion Control insures high combustion efficiency even with unskilled assistants. It makes all necessary adjustments automatically; manual controls are provided for convenience only.



HAGAN CORPORATION • 300 ROSS STREET • PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

PIPEWRENCH PETE SAYS:

THESE 3 SAVINGS MAKE SENSE TO ME!

1 Cut down spoilage, keep production UP! Strong's positive-acting, extra-capacity traps often increase output amazingly — always keep costs DOWN!

★ ★ ★

2 Strong traps just don't seem to wear out! That special, wear-resisting Anumetl makes STRONG valves and seats last eight times as long as even Strong's former parts. You get a full year's guarantee against valve leakage or any replacement.

★ ★ ★

3 How much can positive opening and tight closing of your traps save on steam? Get these savings with STRONG'S *anti-balancing* device! Valve opens wide to discharge condensate, then closes tight—no dribbling! Positive action, plus Anumetl valves and seats can easily save more than the trap costs, in steam alone.

★ ★ ★

MONEY-BACK GUARANTEE! Test Strong traps on your toughest jobs. If not satisfied at the end of 90 days, return them, and your money will be refunded.

HOW DO YOU SIZE STEAM TRAPS? An easy method, plus valuable information on installations, etc. Get Catalog 63-PE2

THE STRONG, CARLISLE & HAMMOND CO.
1392 WEST THIRD ST., CLEVELAND, OHIO

STRONG
STEAM TRAPS

U. S. Civil Service Commission announces addition to the radio mechanic-technician group of the grade of Chief at $2600 a year. Other grades are Principal at $2300, Senior at $2000, Radio at $1800, Asst. at $1620, Junior at $1440. Closing date for applications has been extended until further notice. Applicants must be citizens of the U. S.; must within the 5 years preceding have had a year of paid full time technical radio work; or must have completed 6 mo. radio course in an acceptable radio school; or must have successfully completed a year of study in an engineering school which has included courses in radio; or must have completed a U. S.-sponsored Defense Training course in some branch of radio work, attested by documentary evidence. For a Chief, 3 years' experience is required; for a Principal 2 years; for a Senior, 18 mo.; for a Radio, 1 year; for an Assistant, 6 mo. A year of resident study in an engineering school will count as 6 mo. experience. Age limits are 15th to 53rd birthday.

Application forms, which can be had at any first or second-class postoffice, or from the Civil Service Commission, Washington, D. C., must be filled out completely.

New building with equipment and machinery to triple production of Fairbanks-Morse Diesel engines for the U. S. Navy is being provided by expenditure of 5½ million dollars as announced in a "letter of intent" from Secretary Knox. Production on a large scale is expected within a year. Floor space of 300,000 sq. ft. will furnish quarters for 1200 to 1500 employes, covering machine and welding shops, storage, erecting test and assembly floors, shipping department, hospital, engineering department and offices.

Magnesium, used in aluminum-alloys for airplanes, is now obtained from sea water, as announced by Dr. R. H. Harrington of G.E. Research Laboratory. Production in 1940 was 12 million pounds and for 1941 points 30 million pounds, as compared with six million pounds in 1939.

Battelle Institute research engineers find themselves nearing a goal long sought of devising a magazine-heater stove to use bituminous coal, requiring infrequent attention and free from objectionable smoke.

Ashcroft Gauge Division of Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut, is celebrating its 90th birthday this year. The makers state that just 90 years ago Mr. Ashcroft built the first Bourdon Tube pressure gauge built in the United States, this principle of making pressure gauges having been invented by a French professor named Bourdon. Ashcroft saw this gauge on exhibition at the first International Industrial Exposition in London in 1851, and obtained the exclusive rights to manufacture it in the United States.

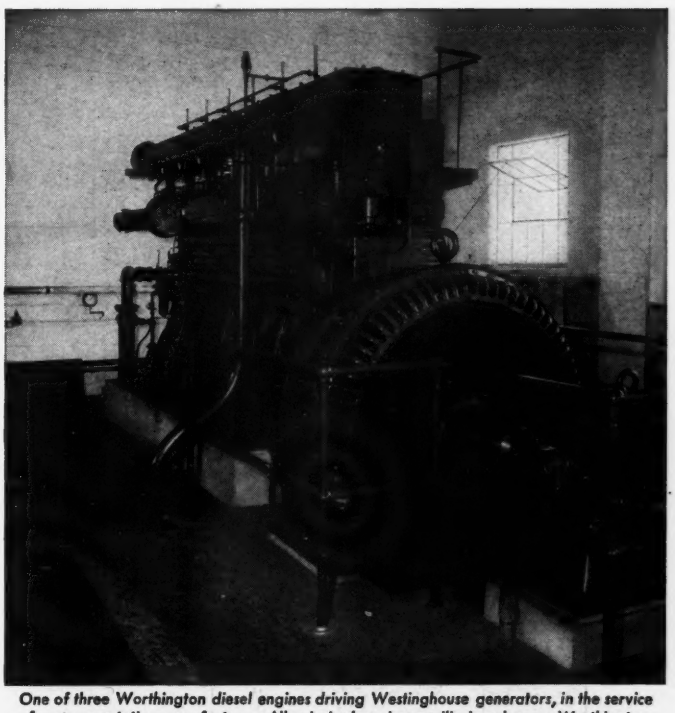
The makers say that a thorough search discloses that there is no recognized name for the 90th anniversary, so they have corrected this by calling this 90th anniversary—the stainless steel.

Appointment of Edmund D. Monk as manager of power transformer sales for General Electric's Central Station Department at Pittsfield has been announced by L. R. Brown, manager of the company's transformer division, to succeed the late L. L. Biche. Mr. Monk completed the course in electrical engineering at the University of Toronto in 1908, afterward a one-year post-graduate course, then entered the G-E Test course in 1909, at the Pittsfield Works. In 1912 he was assigned to the General Office at Schenectady, later in the same year was transferred to Cincinnati as a district transformer specialist, served in the same capacity at Cleveland for a two-year period starting in 1924, and then returned to Pittsfield as assistant to Mr. Biche.

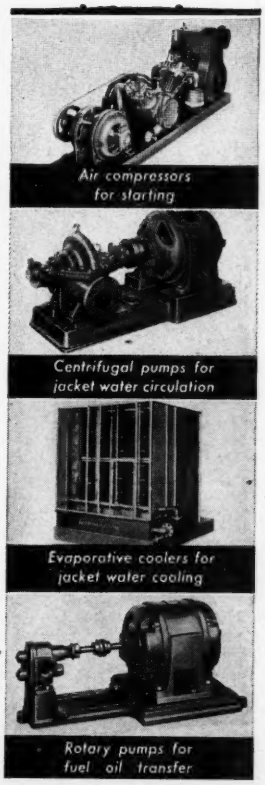
Granby Dam on the western slope of the Rockies will soon be started. The object of the series of dams, known as the Colorado-Big Thompson project, is to transfer waters from the Colorado to the eastern slope of the mountains as a supply for irrigation of 615,000 acres, at the same time generating energy for defense industries. Green Mountain Dam, a 309-ft. rock and earth fill, now half completed will store 152,000 acre feet of water and have capacity of 21,600 kw. Granby Dam is of earth, 225 ft. high, with storage for 482,680 acre feet, water to be pumped from it at 130 ft. lift to a canal whence it will flow by streams and a 13-mile tunnel to the Big Thompson near Estes Park where five plants will utilize a fall of 2800 ft. head. Irrigation will be then distributed to lands of Northern Colorado Water Conservancy District.

Uninterrupted POWER

a defense factor of basic importance



One of three Worthington diesel engines driving Westinghouse generators, in the service of a representative manufacturer. All principal engine auxiliaries also are Worthington.


Air compressors for starting
Centrifugal pumps for jacket water circulation
Evaporative coolers for jacket water cooling
Rotary pumps for fuel oil transfer

Worthington auxiliaries give additional service security, through the undivided responsibility of one maker

WORTHINGTON diesel and gas engine performance . . . in its effect on this important factor . . . is a matter of definite record in hundreds of installations and in a wide variety of applications.

In industrial, municipal, water works, sewage disposal, and in many special applications, Worthington engines are maintaining high operating efficiencies and *unbroken performance* over long periods of service.

Worthington's staff of qualified engineers will be glad to assist you with a thorough study of your power problem and submit a strictly unbiased recommendation for your individual conditions.

DIESEL ENGINES
150 to 1500 hp.

GAS ENGINES
175 to 2160 hp.

CONVERTIBLE GAS-DIESEL ENGINES
150 to 1500 hp.

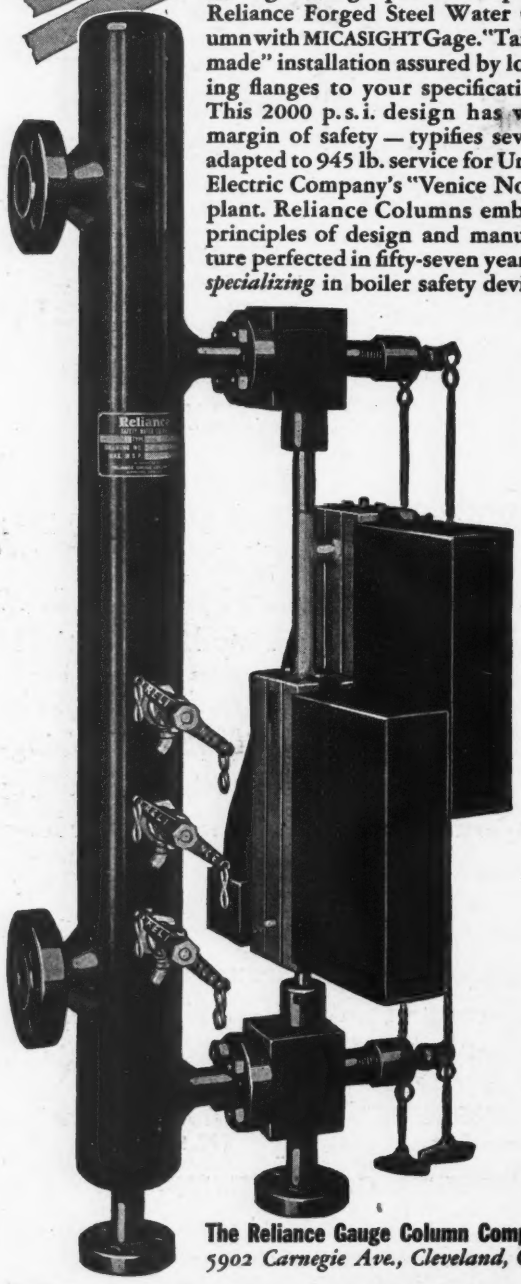
WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: HARRISON, NEW JERSEY

DE1-9

WORTHINGTON

Reliance Super-Vision for Boiler Water Levels to 2000 lbs.

For accurate safe water level reading on high pressures, specify Reliance Forged Steel Water Column with MICASIGHT Gage. "Tailor-made" installation assured by locating flanges to your specifications. This 2000 p.s.i. design has wide margin of safety — typifies several adapted to 945 lb. service for Union Electric Company's "Venice No. 2" plant. Reliance Columns embody principles of design and manufacture perfected in fifty-seven years of *specializing* in boiler safety devices.



The Reliance Gauge Column Company
5902 Carnegie Ave., Cleveland, Ohio

BOILER SAFETY DEVICES since 1884

Reliance

The Office of the Bituminous Coal Consumers' Counsel, Washington, D. C., has a complete set of the analyses used by the District Boards in originally classifying their coals, to which has been added later and additional analyses that are introduced in hearings from time to time. Any consumer who is interested in the analytical value of specific coals can obtain copies of whatever analyses are available for these coals by writing to this office. In order to identify the coal information regarding the size and producer of the coal in question and also the name of the mine from which it comes must be given.

One of the largest magnetic variable-speed drives yet to be applied to an induced draft fan has been ordered from the Electric Machinery Mfg. Co. by the Boston Edison Co. for its new Mystic station at Everett, Mass. The magnetic drive will be rated 1250-hp., 858 to 90 r.p.m. and will be operated by a 1250-hp., 885 squirrel-cage induction motor. The induced draft fan which the new unit will control will serve the station's No. 1 steam generator.

Sectional officers of the National Safety Council were elected at the 30th National Safety Congress and Exposition in Chicago October 6-10. Those having charge of the Public Utility Section include: General Chairman, P. L. G. Hasskarl, Pennsylvania Power & Light Co., Allentown, Pa.; Vice-Chairman, D. C. Duncan, Appalachian Electric Power Co., Bluefield, W. Va.; Secretary, E. S. Miner, American Telephone & Telegraph Co., New York, N. Y.; Engineering Committee, J. M. Orts (chairman), Public Service Corp., Newark, N. J.; Data Sheet Sub-Committee, E. L. Fitzgerald (chairman), Ohio Edison Co., Springfield, Ohio; Safety Instruction Card Sub-Committee, E. A. Rust (chairman), Erie County Electric Co., Erie, Pa.

Bureau of Yards and Docks, Navy Department, has ordered two 10,000-kw. mobile steam-electric power plants mounted on special railway cars from the General Electric Co. to supply emergency power wherever required. One unit will be located on the west coast and the other on the east coast.

Each unit, housed in specially built railway cars, will contain turbine-generator and its accessories, a condenser, and the necessary switchgear. The boiler and its auxiliaries, along with a starting engine generating set will be housed in a second car. Mobile substation constructed on a standard car, will be used in conjunction with each generating unit to permit proper voltage to be obtained for any Naval Shore Establishment.

Bunker C fuel oil will be used, with sufficient fuel supply for 2 hr. operation carried in the boiler cars of each of the units. Natural circulation type boiler for each unit will furnish 140,000 lb. of steam per hour, at 550 lb. steam and 825 deg. F. Generators, operating at 3600 r.p.m. to produce 60-cycle, 3-phase power at 13,800 volts, will be forced air cooled.

Honored by N.E.M.A.

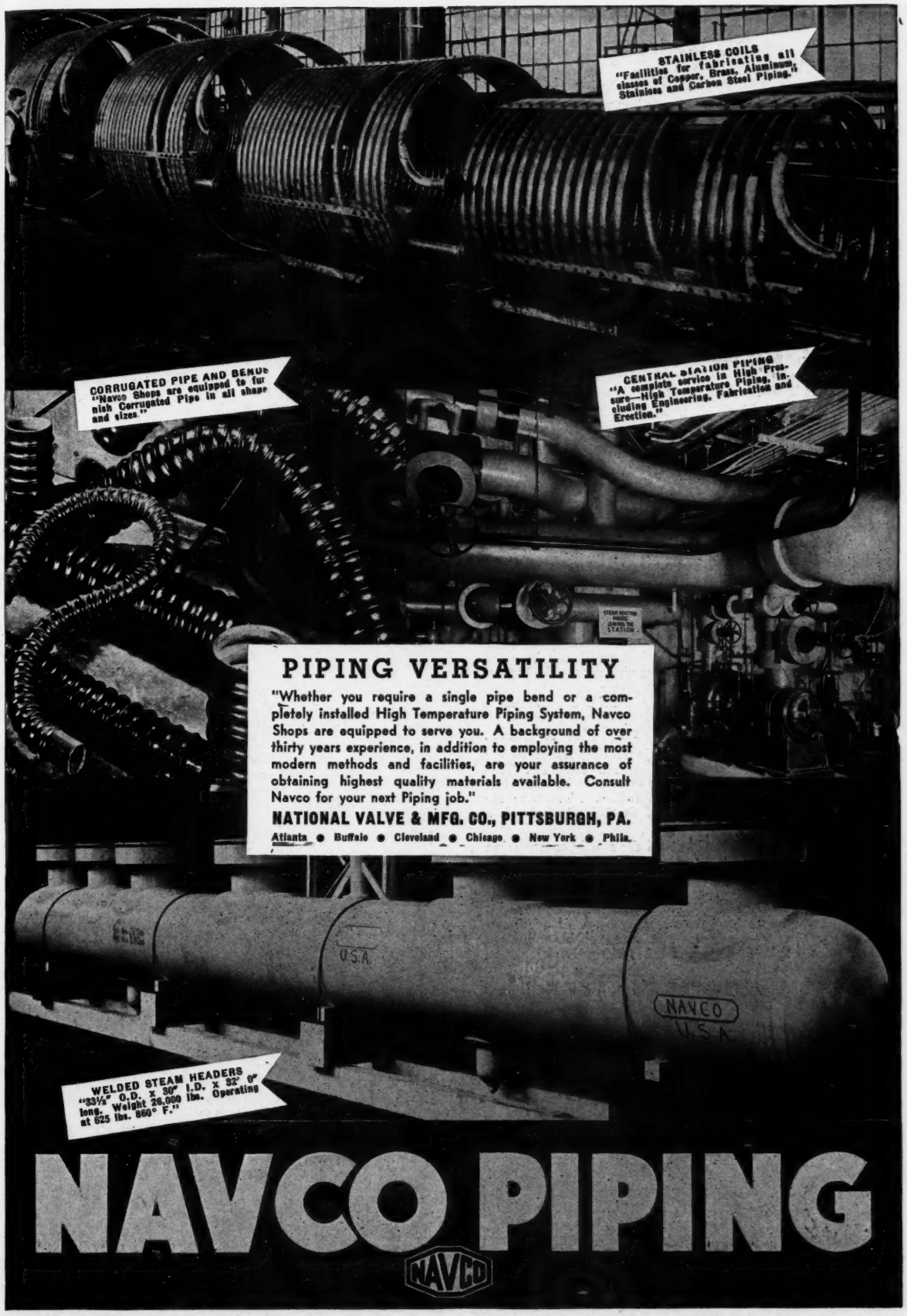
FRANK G. VAUGHEN, manager of the General Electric Co.'s meter division, W. W. Nichols, assistant to the president of Allis-Chalmers Manufacturing Co.; G. E. Palmer, president of Palmer Electric & Manufacturing Co.; and G. E. Salisbury, chairman of the board of Pass & Seymour, Inc., were recipients of 50-yr. certificates at the annual luncheon of the National Electrical Manufacturers Association. The presentations were made by Earl O. Shreve, retiring president of NEMA and vice president of General Electric.

Frank Vaughen was 17 when he became a meter tester for the Thomson-Houston Electric Co., where he tested Professor Elihu Thompson's watthour meter which was to win wide recognition and prizes at Paris Expositions and elsewhere.

Recognizing early his talents for selling, the company sent Vaughen out to publicize watthour meters.

He solved the problem of meter creep and took out a patent on the idea; also demonstrated in court to citizens of Dallas, Texas, that the instrumens were not "robbers" and that the dial hand did not "jump ahead 1000" when one lamp was turned on.

In 1900, Mr. Vaughen moved from Boston to Schenectady, where he still concentrated on meters, became sales manager for the Meter Division in 1907, and in 1923 was appointed manager of the G-E Meter Division, the position he still holds.


STAINLESS COILS
"Facilities for fabricating all classes of Copper, Brass, Aluminum, Stainless and Carbon Steel Piping."
CORRUGATED PIPE AND BENDS
"Navco Shops are equipped to furnish Corrugated Pipe in all shapes and sizes."
CENTRAL STATION PIPING
"A complete service in High Pressure—High Temperature Piping, including Engineering, Fabrication and Erection."
PIPING VERSATILITY
"Whether you require a single pipe bend or a completely installed High Temperature Piping System, Navco Shops are equipped to serve you. A background of over thirty years experience, in addition to employing the most modern methods and facilities, are your assurance of obtaining highest quality materials available. Consult Navco for your next Piping job."
NATIONAL VALVE & MFG. CO., PITTSBURGH, PA.
Atlanta ● Buffalo ● Cleveland ● Chicago ● New York ● Phila.
U.S.A.
NAVCO
U.S.A.
WELDED STEAM HEADERS
"33½" O.D. x 30" I.D. x 32' 0" long. Weight 26,000 lbs. Operating at 625 lbs. 860° F."
NAVCO PIPING
NAVCO

Why it pays to Buy and Use

W-S FORGED STEEL FITTINGS

COMPLETE LINE—No line of fittings is more complete; of higher quality; or better made than W-S Forged Steel Fittings. Switching from line to line to meet your fittings requirements is eliminated when you buy and use W-S Fittings.

W-S Forged Steel Fittings in both socket welded and screw end types, are quality built in a wide range of capacities to fulfill stiffest kind of high speed, free-flowing, pipe line service. They are forged from steels possessing extra toughness, strength and resistance to temperatures and shock.

QUICK SERVICE is given distributor requirements; a benefit which means the best possible deliveries, assuring customer satisfaction.

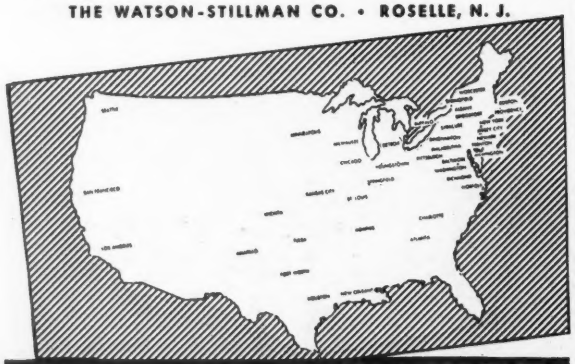
W-S have an active interest in the distributor's business and his progress because W-S was founded and built by following a strict policy of selling only through authorized stock carrying distributors. Today in more than 40 leading industrial centers throughout the United States, W-S Forged Steel Fittings flow smoothly through better than 150 different closely associated distributing outlets.

EXTRA BUYING HELP — As our national emergency mounts, time becomes an ever increasing factor in the purchasing of materials and finished products. This means new, reliable sources of supply will be needed to meet the increasing demands of industry. That's where you will find this W-S Forged Steel Fittings book a helpful guide.

Bulletin No. A-3 shows in detail the sturdy construction and inside reasons for the long life, exceptional resistance to wear and low maintenance cost of W-S Forged Steel Fittings.

You need this book to eliminate many of those unnecessary details in seaching for a quality line of forged steel fittings. Get it—Study it—Use it to enlist the large facilities of W-S Forged Steel Fitting Division and distributor outlets.

THE WATSON-STILLMAN CO. • ROSELLE, N. J.



WATSON-STILLMAN

663

D. Robert Yarnall to Receive Hoover Medal

ANNOUNCEMENT is made that D. Robert Yarnall, mechanical engineer of Philadelphia, Pa., has been selected as the fifth recipient of the Hoover Medal, to be presented during the annual meeting of the A. S. M. E. in New York City, December 1-5, 1941, with the following citation:

"D. Robert Yarnall, humanitarian, engineer, and a leader in the engineering profession, who rendered outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding refugees in this country and Europe and providing food and relief for the children and mothers of France. These distinguished public services have earned for him the Hoover Medal for 1941."

Mr. Yarnall was born June 28, 1878, in Delaware County, Pa., and shortly after his collegiate career went to work for the Coatesville Boiler Works and allied companies as an engineer and remained with them for 5 yrs. His next position was with Stokes & Smith Co., Philadelphia, and in 1912 he became vice-president and general manager of Nelson Valve Co., Philadelphia, and held this position until 1918. In 1912 he organized, formed and became a co-founder with B. G. Waring, of the firm of Yarnall-Waring Co. and has been continuously identified with the company to the present time, today holding the office of vice-president and chief engineer of the company. He is also a director and vice-president of the James G. Biddle Co. and of the Pullenlite Co., both of Philadelphia.

Mr. Yarnall was a member of the Board of the United Engineering Trustees, Inc., a joint agency for the four Founder Societies of civil, mining and metallurgical, mechanical and electrical engineers, from 1934 to 1939, serving as its president for the year 1936-37.

He served as both a member and chairman of the Commission in Europe having charge of feeding German children in 1920. In 1924 and 1938 he was again sent to Germany under the auspices of the American Friends Service Committee. Again, in January 1941, Mr. Yarnall, under the same auspices, went to England to investigate the relief situation there and to assist in expediting shipments of milk and medical supplies for the support of the A. F. S. C. relief program in France for the relief of children and mothers; all of this in cooperation with the Red Cross. Mr. Yarnall is now Chairman of the Refugee Section of the American Friends Service Committee.

Compressed Air Institute Contest

CONTEST is announced by Compressed Air Institue for articles on use of compressed air, to start Dec. 1, 1941 and close June 1, 1942. Any phase of compressed air application may be treated, including production, transmission, all sorts of tools. Any suggestions as to speeding up Defense work will be referred to the proper Government agency, with full credit to the contestant, whether or not prize is awarded.

Judging will be on usefulness of the ideas submitted, originality, breadth of application and completeness of treatment. Skill in writing, and excellence in English will have no particular weight. Cash awards will be: first prize $100; three prizes of $50 each; ten prizes of $25 each; as many additional awards of $25 as there are contestants whose material submitted is acceptable for use in technical journals. Any employe of any organization using compressed air, either alone or in combination with other power is eligible, except employes of members of Compressed Air Institute.

Contest announcements, 11 by 17 in., for bulletin boards giving all rules and suggestions may be had from Russell Gross, Educational Director, East Orange, N. J.

Massachusetts License Law Amended

AT THIS year's session of the Massachusetts legislature a bill calling for the renewal of all Engineers' and Firemens' licenses was passed, signed by the Gov. and became effective November 1, 1941.

This law effects all engineers, firemen and boiler inspectors holding Massachusetts licenses, except licensed men who are in the military service, who are exempt until a date three months after discharge from military service.

Applications for renewal may be obtained at the office of the Dept. of Public Safety, Division of Boiler Inspection, 3 Hancock St., Boston, Mass.

Fee for renewal is $1.00, and the address to which the application must be sent is on the application.

Renewal must be made in 3 mo. or the holder will have to stand re-examination.

DEPENDABLE POWER

De La Vergne Diesel Engines

● Today's production requirements demand uninterrupted power supply. World conditions make it imperative that every possible safeguard be taken to prevent power failure.

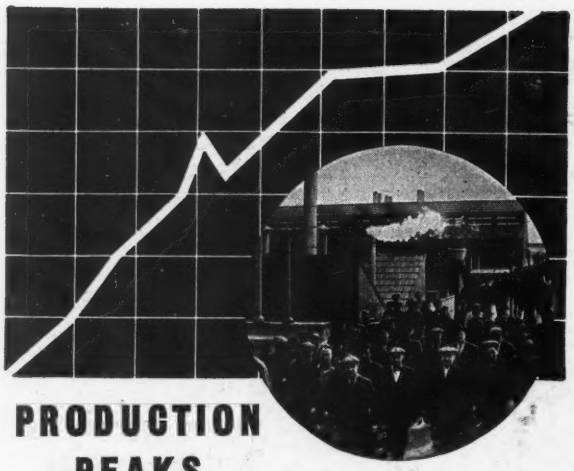
Your best insurance for an uninterrupted power supply is a De La Vergne Diesel Engine. Known throughout the country for their dependable and economical operation, De La Vergne Diesels are available in sizes from 200 bhp to 1,500 bhp. Let De La Vergne engineers investigate your power problem.

Baldwin De La Vergne Sales Corporation, Philadelphia, Subsidiary of The Baldwin Locomotive Works.

Baldwin De La Vergne SALES CORP.

SUBSIDIARY OF THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

BLW THE BALDWIN GROUP



PRODUCTION PEAKS

Demand Efficient Workers

War-conditioning to keep our Country great, free, powerful and happy demands production peaks of every useful industry. Where employees can labor comfortably and healthfully, they work at top efficiency and achieve production peaks. Only with modern methods of heating, ventilating and air conditioning will employees' efficiency and morale best meet the strains of the day.

How well are you personally equipped to judge what is needed to guard your interests by conserving man-power?

There is no better way to fit yourself to act wisely and promptly on these pressing problems than to visit the 7th International Heating and Ventilating Exposition—the Air Conditioning Exposition—at Philadelphia in January.

Be sure to visit this outstanding biennial event so you can act with greater assurance and confidence. You owe that to your business, your associates, your Country and yourself.

7th INTERNATIONAL HEATING & VENTILATING EXPOSITION

The Air Conditioning Exposition

COMMERCIAL MUSEUM · PHILADELPHIA · JANUARY 26-30, 1942

Under the Auspices of American Society of Heating and Ventilating Engineers

MANAGED BY INTERNATIONAL EXPOSITION COMPANY 776-B

Buy a Share in America

To PRESERVE our position as free men and women in America to think, speak and worship as we choose, we—America—are embarking on a huge defense program. It will take billions of money for a two-ocean navy, for an adequate army, for tanks, planes, artillery and other equipment. It is our program, in which each of us must share and from which each of us will benefit. To take a direct part in building defenses, the simple way is to buy a share in America by purchasing U. S. Defense Savings Bonds. This will help finance the defense program by lending to the Government, at the same time will set up a backlog for the future by securing a sound, interest-bearing investment.

For individuals, the series E bonds are available at any bank or post office in denominations as follows:

Maturity Value	Cost Price
$ 25	$18.75
50	37.50
100	75.00
500	375.00
1000	750.00

Held to maturity at 10 years, a bond returns 2.5 per cent interest a year, but in emergency can be redeemed earlier, though at a lower interest rate, any time after 6 months, on 30 days writen notice.

Bonds may be registered in the name of any individual, hence are available as Christmas gifts to others.

This is a simple, direct, remunerative method to Buy a Share in America.

Connecticut Light & Power Expanding Devon Plant

CONNECTICUT Light & Power Co., Hartford, Conn., has work under way on expansion in Devon steam-electric generating station, to include installation of new 45,000-kw. turbine-generator unit, high pressure boilers and auxiliary equipment. Completion is scheduled in 1942. Closely following, company will proceed with further enlargements in same plant, with installation of another turbine-generator of like rating, with complete accessory equipment. This part of program is scheduled to be ready for service about 18 to 24 months later. The expansion will increase rating of Devon station to about 194,000-kw. Work will include extensions in transmission lines, power substations and other operating facilities. Company is arranging for sale of block of new preferred stock, to aggregate about $10,000,000, a considerable part of this fund to be used for station expansion noted.

Generating Station To Operate On Desulphurized Gas

THE ARKANSAS Power & Light Co., Pine Bluff, Ark., plans to use desulphurized gas for fuel for new steam-electric generating station to be located in vicinity of the McKamie gas field, Lafayette County, Ark. For this purpose, the McKamie Gas Cleaning Co., McKamie, recently organized joint subsidiary of the Atlantic Refining Co., Philadelphia, Pa., and the Carter Oil Co., Tulsa, Okla., has plans nearing completion for the construction of a new desulphurization plant for treating "sour" gas. It will comprise several large units, with compressor station, pipe lines and other structures, estimated to cost close to $500,000, with equipment. Initial plant will be increased for double proposed capacity, with expenditure of $1,000,000, providing that Arkansas-Louisiana Gas Co., Pine Bluff, a subsidiary of Cities Service Co., New York, N. Y., secures contract for furnishing natural gas for new aluminum mill to be constructed by Aluminum Co. of America, Inc., Pittsburgh, Pa., near Benton, Ark., for production for Government. This latter plant will represent an investment of about $23,000,000, and will require large quantity of natural gas. Arkansas Power & Light Co., will proceed with erection of its new plant at early date, estimated to cost close to $3,000,000, and for which natural gas requirements will approximate from 8,000,000 to 10,000,000 cu. ft. per day.

Training for the Navy

THE NAVY Department, aware that private industry needs many engineers, has modified the qualifications necessary for admission to a 4 mo. training period leading to a commission as an engineering officer in the U. S. Naval Reserve.

Young men who have completed 4 yr. at an accredited college or university, including 2 yr. of mathematics and courses in physics and in chemistry are educationally qualified for enrollment, regardless of the kind of degree or lack of degree. On successful completion of their 4 mo. training course, they will be commissioned Ensigns, which is the same rank held

WHEN YOU "UP"
YOUR STEAM CAPACITY

...remember that this plant builds equipment that will keep your steam costs DOWN

Here is a plant that produces "defense materials" for a war against waste — a complete line of heat recovery and its accessory equipment for the maximum utilization of every heat unit coming from your fuel.

This equipment includes forced and induced draft fans, custom built for every service; cinder traps having a good recovery and a low draft loss; cast iron and steel economizers providing high heat transfer; and air preheaters of both tubular and plate types for high waste heat recovery with low maintenance.

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Above—Davis No. 134 Balanced Swing Check Valve for simple, positive check valve service.

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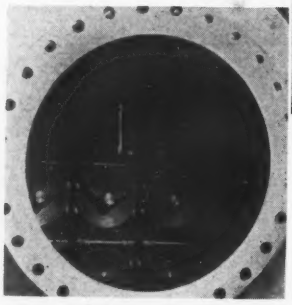
Above—Davis No. 130 Turbine Bleeder Non-Return Valve for certain safety control. Equipped with oil cylinder for automatic emergency closing.



Left—Davis No. 132 Multiple Disc Non-Return Valve for trouble-free low pressure service.

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by U. S. Naval Academy graduates, except that their duties are in engineering only, rather than as both deck and engineering officers.

The classification, Engineer Volunteer General, is filled by qualified men to perform tasks at sea that require engineering knowledge. It is in this classification that the need is most pressing at present. Quotas for deck officers are filled.

Applicants, in addition to meeting the educational requirements must be between the ages of 21 and 28, be native-born, unmarried, and able to meet the physical qualifications of an ensign. The term of service is for 4 yr. or less, depending on the duration of the emergency, with the possibility of permanent, voluntary retention.

Anyone interested should write to the Commandant, Ninth Naval District, Great Lakes, Illinois, for complete information.

Stokers to Increase Production

TO STEP UP PRODUCTION for our expanding defense program and supplying the nations abroad, Thomas A. Marsh, national industrial engineer of the Iron Fireman Manufacturing Co., suggests the following six ways that automatic coal stokers can help:

1. Steady automatic firing increases boiler output, as plants all over the country have increased steam production 25 to 40 per cent by installing stokers in existing as well as new boilers.

2. The automatic stoker widens the range of dependable coals which can be used, often making it possible to fire local coals if transportation from distant fields is restricted.

3. Automatic stoking greatly reduces the work of firemen, decreases labor cost, may release part of the fireman's time for other work, and improves boiler room working conditions, which is an important factor today when experienced firemen and engineers are difficult to find.

4. Of prime importance, also, is ability of automatic coal stokers to provide reliable steam supply and a steady steam pressure which insures constant operation.

5. Stokers are easily adapted to existing boiler plants, so that no long shutdown is required to install them.

6. Stokers burn a lower cost coal, and less coal because of the complete combustion and steady firing.

Measurement of Water Purity

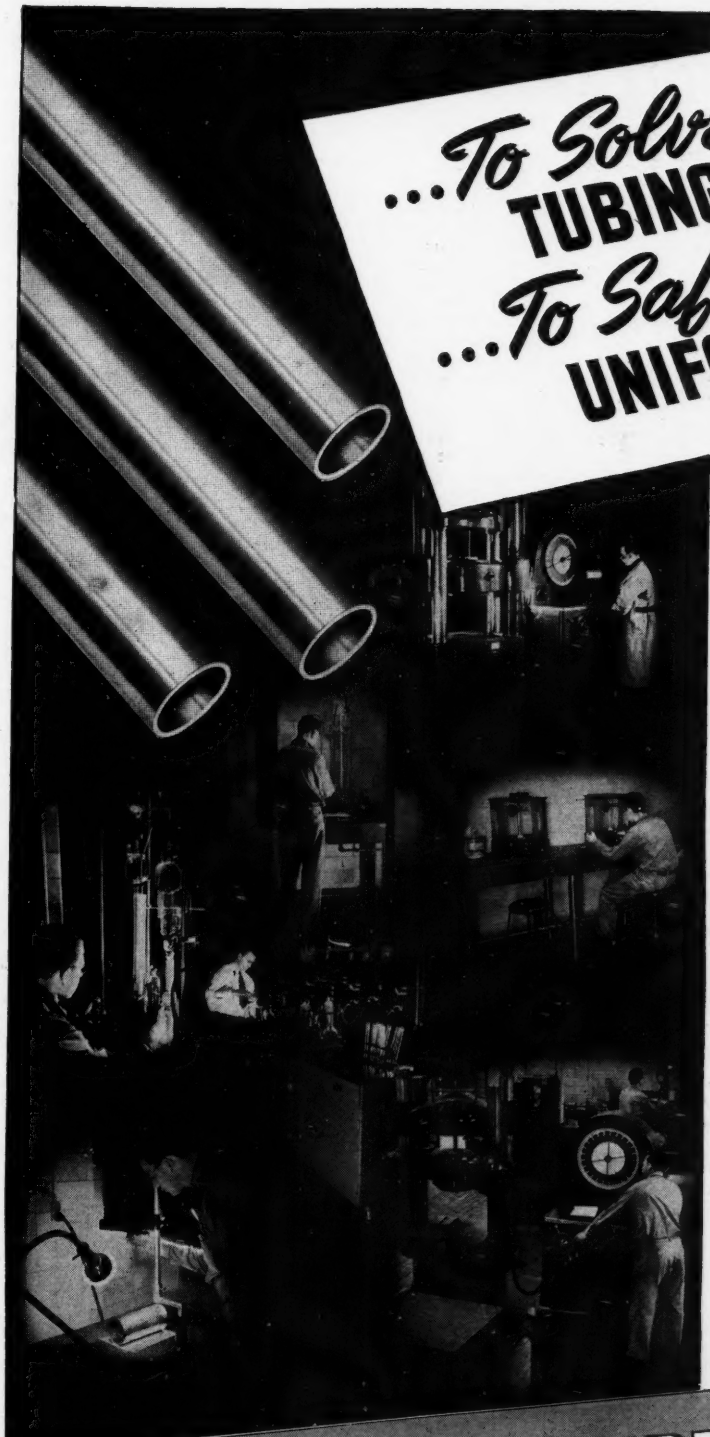
ELECTROLYTIC CONDUCTIVITY measurement is coming into wide use in laboratories and industrial plants as a means of checking concentration of solutions, purity of water and the like, also concentration of solids in tap water, in boiler water and in condensates. Even slight traces of impurities will affect specific resistance to a marked degree. For such use, the conductivity bridge will measure specific resistance from 0.2 to 2,000,000 ohms with accuracy of 1 per cent except near extreme ends of calibrations. Nathan Scholl of Industrial Instruments, Inc., advocates this method for checking purity of distilled water, control of water used in industrial processes, strength of electrolytes, moisture or impurities in organic compounds, and for routine examination of boiler feedwater.

Welded Stack Weighs Less

CLEVELAND ELECTRIC ILLUMINATING CO. recently found it necessary to save as much weight as possible in constructing its new Lake Shore power plant on a mat foundation that formerly supported a plant of less generating capacity razed in 1931. A saving of 25 per cent in the weight of two 260-ft., ceramic-lined, self-supporting, steel smokestacks was made possible through the use of electric welding, General Electric welding machines being used and approximately 2250 lb. of electrodes.

Stacks are 13 ft. in diam. from roof level to top. Plates $\frac{3}{8}$ in. thick were used to a height of 47 ft. above the ground, the upper part being made of $\frac{5}{16}$-in. stock. To support the lining and to provide a circumferential stiffening, shelf angles were welded inside the shell at intervals of 20 ft., with a steel ladder welded to each stack.

All joints, both circumferential and vertical, were butt-welded. Each vertical joint was placed 90 deg. around the stack from the preceding vertical joint. The steel plates were hoisted into place and welded with power from welding machines located on the roof of the plant. More than 1000 lineal feet of welding were required for the shell of each stack.



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New Engineering Books

Standard Handbook for Electrical Engineers. Seventh Edition. Archer E. Knowlton, Editor-in-Chief. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y., 1941. 6 by 9 in., 2304 pp., semi-flexible simulated leather binding, thumb indexed. Price $5.00.

This seventh edition of the Standard Handbook marks a complete change in its physical makeup and also a complete revision of the material contained in it. Heretofore it has always been 4¾ by 7 in. in size but now it makes its appearance as a 6 by 9 in. volume, and with large type.

Before planning this edition, the editors interviewed over 100 electrical engineers in well diversified professional activities to find out what they expect of an engineering handbook. One fact stood out above all others and that was the demand for an orderly compilation of the working tool information of electrical technology not generally accessible in compact form. Support was also obtained for terse condensation of abstract principles so that maximum space could be devoted to the presentation of accepted data. This new edition is, therefore, designed to be primarily an encyclopedia of applicable information and secondarily an epitome of the academics of electrical phenomena.

The majority of the contributors are new, but all were selected for their authoritative standing. Prominent among the changes effected in this edition is an expansion of the former section on power plant electrical equipment to embrace electrical equipment for the whole power system. Power transmission, electronics and radio, interior wiring, illumination, prime movers, and telephones are other basically new treatments. Recognition is given to such typically modern developments as air conditioning, electricity in aviation and in the petroleum industry, lighting technology, high-voltage generators and cyclotrons. The compilation of codes and standards has been greatly expanded so that users may know where to obtain standard specifications and prescribed practices.

The most noticeable change, already mentioned, is in the physical dimensions of the book and the typography. This is a most welcome change. Previous editions, possibly in an effort to preserve the "pocket-" or "hand-" book idea, had grown unduly bulky. The new size is much easier to handle and on the whole much more usable.

The new Editor-in-Chief, Archer E. Knowlton, is associate editor of the Electrical World, a Fellow of the American Institute of Electrical Engineers and formerly associate Professor of Electrical Engineering at Yale University. R. M. Shoop is Assistant Editor. It is impractical here even to list the contributing editors but they include men widely noted for their achievements in electrical engineering and all of them occupy important positions in the industry.

Telemetering, Supervisory Control and Associated Circuits. Published by the American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y. 1941. 27 pp., 8½ by 11 in. paper covered booklet. Price 40 cents to members of the A.I.E.E. 80 cents to non-members.

This is a report of a joint subcommittee of the A.I.E.E. Committees on Automatic Stations and on Instruments and Measurements. It summarizes information regarding electric telemetering and supervisory-control systems in use today and includes a detailed discussion of the interconnecting circuits suitable for such purposes. Although telemetering and supervisory equipment are electrical developments and widely used in the electric power industry, their greatest—and rapidly growing—field of application is in non-electrical industries. In the water, oil and gas industries, for example, the use of these remote metering and remote operating controls has become an important factor in the economical transportation of these vital commodities through pipelines. The material presented is concise and comprehensive. All known commercial sources of telemetering and supervisory control apparatus in the U. S. were canvassed and every effort was made to present a complete picture of the instruments and systems available for the purpose.

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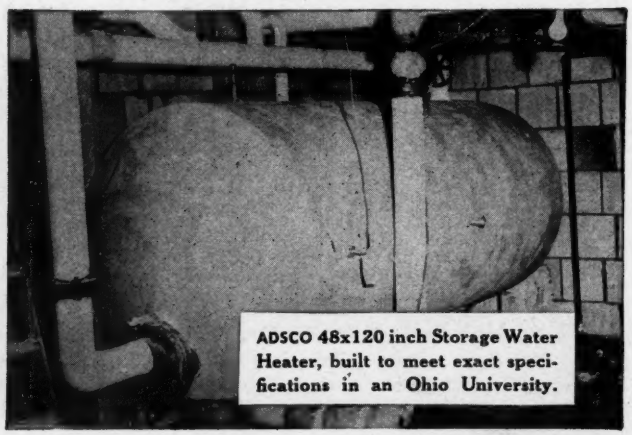

ADSCO 48x120 inch Storage Water Heater, built to meet exact specifications in an Ohio University.

Industrial Instruments for Measurement and Control. By Thomas J. Rhodes. First edition. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y., 1941. 6 by 9 in., 573 pp., 283 illustrations, cloth. Price, $6.00.

This book is intended for use as a textbook for the formal study of the subject of instruments and automatic control in engineering schools and as a practical reference book for those concerned with instrument and control problems in industry. The first chapter is devoted to a general consideration of "Standards"—standards of temperature, pressure, flow and liquid level. This is followed by chapters on Pressure and Vacuum gages, Indicating and Recording thermometers, High-temperature pyrometry, Differential-pressure Flow-meter instruments, Liquid level measurements, Telemetering, Automatic-control theory and mechanisms and finally a chapter on Miscellaneous Industrial instruments.

There has been no attempt to include in the text descriptive material on all the available types and kinds of instruments and controls. The author includes only such descriptive material as will help to make clear the theory being studied or which represents a different solution to a particular instrument problem.

The text is well presented with a minimum of mathematics and the mathematical material included can be understood by anybody with a knowledge of simple algebra. It is a good book for the practical man whose work requires him to know something about industrial instruments and control apparatus. The author is an engineer with the Procter & Gamble Co.

Practical Lessons in Arc Welding. By W. J. Chaffee. Third edition in seventh printing. Published by Hobart Brothers Co., Troy, Ohio. 100 pp., 77 illustrations. Paper cover. Price 50 cents. Special edition written in Spanish $2.00.

This concise arc welding book, written in easy-to-understand English, offers students, instructors, engineers, and executives an abundance of practical arc welding data and lessons. Patterned after the course of lessons offered in the Hobart Trade School, this book leads the student easily throughout all the fundamental stages of arc welding. Forty-two complete arc welding lessons are covered in the book.

Group of lessons include: Striking and manipulating the arc; welding with bare electrodes; welding and cutting with coated electrodes; welding light gauge steel. Each lesson gives complete instructions for practicing the exercise—material, position, proper electrode, current value, and polarity setting.

The author stresses practice as a means for acquiring welding proficiency—keeping technical material to a minimum.

Lincoln Electrical Reference. First Edition. Compiled by E. S. Lincoln. Published by the Electrical Modernization Bureau, 60 East 42nd St., New York, N. Y., 1941. 8½ by 11 in. 1200 pp., 1200 illustrations, 326 diagrams and 315 tables. Cloth. Price $15.00.

This is a distinctly different type of electrical reference book from any that have been published. It is a book designed primarily for the industrial or commercial engineer or electrical contractor. Its object is to serve all branches of the electrical industry with a comprehensive and accurate presentation of the facts, tables and general information necessary for everyday work.

The material in this volume, which, by the way, is almost four inches thick, is divided into sections, designated by the letters A to Z. Each section contains the author's presentation of the subject at hand, illustrations and descriptions of typical equipment furnished by the Sponsors, the latter being the principal electrical manufacturers in the U. S., and in so far as possible, all the tables, diagrams and the National Electrical Code pertaining to that particular subject.

Each section devoted to service or utilization equipment is divided into "Installation" and "Operation" sections. Installation covers economic factors, selection of equipment, layout, application and control. Operation includes inspection, maintenance, testing, surveys, analysis of performance, and operating costs.

As some industrial men have not had the opportunity to participate in industrial or professional associations and read current technical periodicals and books extensively, each section of this reference is introduced by some fundamental facts that should aid the effective application of the data presented.

It is a very impressive book and one that should be extremely useful to anybody associated with the field of electrical design or construction. It is simple to use and the up-to-date char-

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acter of the material it contains should make it of particular value at the present time in planning and executing plant extensions for defense work.

An Engineers' Manual of Statistical Methods. By Leslie E. Simon. First Edition. John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1941. 6½ by 9½ in., 232 pp. Seven loose leaf charts. Cloth. Price $2.75.

Statistics, says the author of this book, have been defined as the art of making common sense out of figures. This to a great many people is probably a curious way of putting it because statistics, at least if one judges by the jokes about statisticians, is generally assumed to be anything but common sense. Many people will throw up their hands in assumed horror when the subject of statistics is even mentioned. To those people, particularly if they happen to be engineers, we recommend this book.

The reason for the prevailing ideas about the "dryness" of statistics is due largely to the fact that most of the literature on statistics is written by and for statisticians. The mode of thought and terminology are largely unfamiliar to the uninitiated, and the practical man is likely to wonder what it is all about and why he as an executive, engineer, or industrialist should adopt these new methods when he is doing very well as he is.

Stripped of their verbiage, however, as shown by this new book, statistical methods become very easy and their application is still easier. Mr. Simon, who by way of interest is a Major in the Ordnance Department in the U. S. Army and Assistant Director of the Ballistic Research Laboratory at the Aberdeen Proving Ground, explains statistical methods and shows how to apply them in a way that any engineer or factory manager can understand. He demonstrates their mode of operation and indicates ways in which they can be of service. No advanced mathematics is necessary. The book is designed for the practical man whose interest is centered in his industrial or engineering work. At a time like this when so much emphasis is placed on speed and accuracy of production, statistical methods can be of great value and this book should be welcomed by those who are beset by the problems continually arising in defense production. It is the most readable book the reviewer has seen on the subject.

Electric Power Stations, Vol. 1. By T. H. Carr, with a foreword by Sir Leonard Pearce. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y., 1941. 5½ by 8½ in., 376 pp., 165 illustrations, cloth. Price $7.50.

It is interesting to us here in America that even in war-torn England, engineers engaged in the generation of electric power can find time to write books on the subject. Mr. Carr is an Englishman and his book reflects English practice but the underlying principles of power station design and operation have no nationality and they are as applicable in this country as they are in England. This book is well written; the presentation is logical and simple and it should be of interest to the experienced engineer and student alike—to the former because it presents in compact form a good general picture of present day practice and to the latter as a source of practical information on which he can base subsequent study. To indicate the scope of this volume, the following list of Chapter headings will be of interest: 1. Fundamentals of Station Design. 2. Civil Engineering Works and Buildings. 3. Circulating Water System. 4. Cooling Towers. 5. Coal Handling Plant. 6. Ash Handling Plant. 7. Boiler Plant. 8. Pipework. 9. Turbines.

This book should be of interest to American engineers because of the information it presents on English practice and equipment.

Practical Electrical Wiring. By H. P. Richter. Second edition. 521 pages, 457 illustrations, 6 by 8¼ in. Cloth. McGraw Hill Book Co., Inc. 330 W. 42nd St., New York, N. Y., 1941. Price $3.00.

This is a practical book on practical methods of electrical wiring. It tells in plain, easy language, how to do all kinds of light and power wiring jobs in the home, farm and factory, and presents the basic principles behind the technique in understandable terms. It has been the author's aim to make the treatment simple enough for the beginner yet complete enough to be of value to those already engaged in electrical work. As pointed out in the preface, it is intended to be, not a manual that merely recites the methods used in wiring buildings but, rather, a book that explains the subject in such a fashion that the reader will learn both the way things are done and why they are done in that particular way. All the methods

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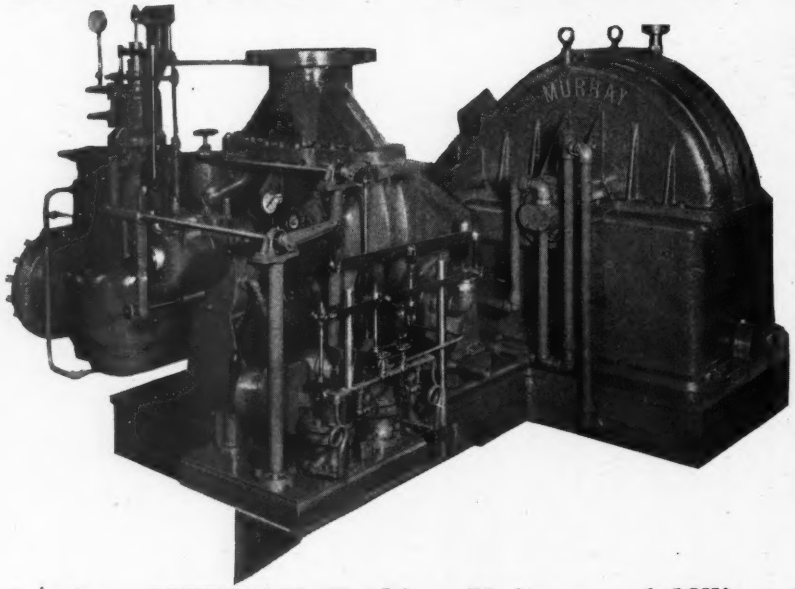

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shown are in strict accordance with the National Electrical Code and this second volume is based on the 1940 Code. The Code itself is not included but the book gives a detailed explanation of all subjects covered by the Code. The volume should be of definite practical value to all who have occasion to do electrical wiring.

Power System Interconnection. By H. Rissik. First edition. 240 pages, 99 illustrations, 5½ by 8½ in. Cloth, Sir Isaac Pitman Sons, Ltd., London. In U. S. A. Pitman Publishing Corp., 2 W. 45th St., New York, N. Y., 1940. Price $7.50.

This small but potent volume is not just another treatise on the apparently inexhaustible subject of electric power. As indicated by the author it is neither intended to survey existing practices in electric transmission nor is it concerned with the many problems associated with the design and operation of individual power stations and distribution networks. The object of this new book is to acquaint the practicing engineer as well as the advanced student with the new analytical and semigraphical methods that have been developed during the past two decades for calculating the performance of interconnected power systems.

This book according to the author has been purposely limited in scope to a consideration of the basic transmission problems underlying the technique of power interconnection as we know and understand it today. That technique, however, is intimately bound up with the solution of other no less vital problems centering upon a variety of extraneous factors which involve the operational behavior of electrical machines by themselves. It is the author's intention to deal with these specifically machine problems at some later date, probably in the form of a companion volume.

The chapter headings are as follows: I. Fundamental Conceptions and Principles. II. Circle Diagrams in Power System Studies. III. The Power Limits of a Synchronous Interconnector. IV. Steady State Stability. V. Transient Stability. VI. Limitations of A. C. Power Transmission Interconnection.

The book concludes with an excellent bibliography and an index.

Power Station Chemistry. Published by the Edison Electric Institute, 420 Lexington Ave., New York City, as Publication No. H-11. Size 8½ by 11½ in., paper bound, 20 pp. Price to members $0.40, non-members $1.00, foreign $1.10.

Edited from the report of the Power Station Chemistry Subcommittee of the Prime Movers Committee of the Institute. It consists of operating company and manufacturers statements supplemented by the interpretation of the committee.

The report presents data on the activities currently being studied, including data on the determination of hydrogen evolution; description of the apparatus used; and, discussion of the information obtained. A progress report on "carry-over" discusses the problem and outlines a tentative program for future work. The report also presents a description of an installation of a carbonaceous zeolite water softener which includes a summary of operating results and costs over a 1 yr. period.

Machine Shop Training Course. By Franklin D. Jones. Published by The Industrial Press, 148 Lafayette St., New York City. Second edition, copyrighted 1941. Size 6 by 9 in., cloth bound. Two volumes; Vol. 1, 527 pp.; Vol. 2, 540 pp. Price two volumes, $6; either volume separately, $4.

At this time when skilled machinists are at a premium, it is impossible to overestimate the value of a course of this kind. It is a practical fundamental treatise on elementary principles, methods of adjusting and using different machine tools, measuring instruments and gages, typical work examples, threads, grinding, gearing, precision toolmaking and typical shop problems.

The second edition does not differ greatly from the first edition which came out last year, with the exception of additional material of considerable importance to students and student instructors. The books are designed for shop courses, technical trade schools and self instruction. Another new feature of importance is an original series of blue print reading charts. This 29 pp. series in color shows by progressive steps how to read and understand mechanical drawings, an essential for a good machinist. See original review p. 131, July 1940 for further details.

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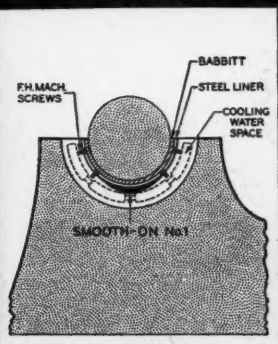

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Power Plant Construction News

Conn., Waterbury—Waterbury Tool Division of Vickers, Inc., East Aurora Street, manufacturer of hydraulic transmissions, etc., plans installation of electric power equipment in new one-story addition, about 92,000 sq. ft. of floor space, for production of equipment for Government. Cost estimated about $1,400,000. Proposed to begin work at once.

Fla., Keystone Heights—Clay Electric Cooperative Association, Keystone Heights, plans expansion in local generating station for power supply for rural electric lines in this vicinity. Cost estimated about $105,000, including equipment. Fund in that amount has been arranged through Federal aid. A. G. Loudon is superintendent.

Ill., Chicago Heights—American Locomotive Co., 30 Church Street, New York, N. Y., will build a steam power house at new plant at Twenty-third Street and Euclid Avenue, Chicago Heights, for production of steel products for Government. Works will comprise a main one-story unit and several auxiliary structures. Entire project is estimated to cost about $500,000. Work will begin soon. United Engineers & Constructors, Inc., 1401 Arch Street, Philadelphia, Pa., is architect and engineer.

Ill., Dixon—Illinois Northern Utilities Co., Dixon, has plans under way for extensions in steam-electric generating station, to include installation of new 50,000-kw. turbine-generator unit and accessories, high-pressure boilers and auxiliary equipment. Also will make extensions in transmission lines. Entire project will cost close to $6,000,000, and is scheduled for completion late in 1943. Sargent & Lundy, Inc., 140 South Dearborn Street, Chicago, Ill., is consulting engineer.

Ky., Winchester—Clark County Electric Cooperative Corporation, J. Hughes Evans, president, plans new steam-electric power plant for service for rural electric system. Cost estimated about $2,000,000, with transmission lines, power substations, switching stations and other facilities. Financing will be arranged through Federal aid.

Mich., Detroit—Chrysler Corporation, 341 Massachusetts Avenue, plans installation of electric power equipment in new additions to plant at 28251 Van Dyke Street, for production of military tanks for Government, comprising several large one and multi-story buildings to double present capacity. Entire project will cost about $18,875,000. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency, for land, buildings and machinery. Work will begin soon.

Minn., Warroad—Border Counties Power Co-operative, Inc., Warroad, T. D. MacKenzie, superintendent, plans new steam-electric generating station in vicinity of Little Fork, near Warroad, for power supply for rural electric system. Estimates of cost and surveys will be completed soon. General Engineering Corporation, 2944 Cedar Avenue, Minneapolis, Minn., is consulting engineer.

Mo., North Kansas City—Corn Products Refining Co., 1001 Bedford Street, plans expansion in power plant at mill, with installation of new 4000-kw. turbine-generator unit, two boilers and auxiliary equipment. Work will be carried out in conjunction with expansion in mill for large increased production, comprising two and six-story additions. Electric power equipment will be installed. Entire project will cost over $1,500,000. Main offices are at 17 Battery Place, New York, N. Y.

N. Y., Canandaigua—Co-operative Grange League Federation Mills, Inc., Chamber of Commerce Building, Buffalo, N. Y., plans installation of electric power equipment in new one and multi-story food-processing and packing plant at Canandaigua. Entire project is estimated to cost over $125,000.

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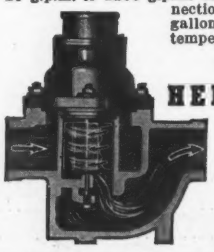

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Ohio, Newton Falls—Village Council has plans under way for new municipal power station, using Diesel engine-generator unit and accessories. Estimates of cost are being made. C. R. Bricker, 216 High Street, Warren, Ohio, is engineer; Carl J. Simon & Associates, Inc., Evans-Central Building, Van Wert, Ohio, is consulting engineer.

Okla., Rush Springs—Midwest Engineering Co., McBirney Building, Tulsa, Okla., consulting engineer, is preparing plans for new steam-electric generating station to be constructed by a rural cooperative electric association, now being organized, at Rush Springs, for power supply for rural distribution systems in that part of State. Initial plant will have capacity of about 22,000-kw. Cost reported close to $2,000,000 with transmission lines, power substations and other facilities. Financing will be arranged through Federal aid.

Pa., Philadelphia—Bendix Aviation Corporation, Abbottsford Road and Wissahickon Avenue, manufacturer of aircraft and other precision instruments and parts, plans installation of electric power equipment in connection with expansion in local plant for production for Government. Company will lease about 120,000 sq. ft. of additional space in former adjoining plant unit of Atwater Kent Mfg. Co. Entire project will cost about $2,900,000. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., a Federal agency.

Pa., Tarentum—Light and Water Department plans extensions and improvements in municipal power plant, including installation of equipment for increased capacity. Cost reported over $80,000. Morris Knowles, Inc., Park Building, Pittsburgh, Pa., is consulting engineer.

R. I., Westerly—Narragansett Electric Co., Providence, R. I., has taken over property at Thompsons Corner, on Pawcatuck River, Westerly, for new steam-electric generating station. Cost estimated about $2,500,000 with turbine-generator unit, high-pressure boilers and auxiliary equipment. Plans will be prepared by United Engineers & Constructors, Inc., 1401 Arch Street, Philadelphia, Pa., consulting engineer. Work will be carried out in 1942.

Texas, Galveston—Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo., manufacturer of industrial chemicals, etc., plans installation of electric power equipment in new plant in vicinity of Galveston, for production of chemical specialties used for synthetic rubber manufacture. It will comprise several one and multi-story buildings. A boiler house is planned. Entire project will cost about $2,200,000, and fund in that amount will be secured through Defense Plant Corporation, Washington, D. C., a Federal agency.

Texas, Houston—General Printing Ink Corporation, 100 Sixth Avenue, New York, N. Y., manufacturer of inks and kindred products, plans installation of electric power equipment in proposed new plant at Houston, where site is being selected. Cost estimated close to $100,000.

Texas, Littlefield—Town Council has plans for new municipal power plant and electrical distribution system. Proposed to use Diesel engine-generator units and accessory equipment. Entire project is estimated to cost about $275,000. A bond issue in that amount is being arranged.

Texas, Terrell—Municipal Light Department has plans under way for extensions and improvements in municipal power plant, with installation of additional equipment. Cost reported close to $75,000, including betterments in electrical distribution lines. Albert C. Moore & Co., Smith-Young Tower Building, San Antonio, Tex., are consulting engineers.

Utah, Mount Emmons—Moon Lake Electric Association, Inc., S. K. Daniels, president, plans extensions in recently completed power station, including installation of equipment for increased capacity. Cost estimated about $50,000. Fund in that amount has been arranged through Federal aid. Walter W. Flora, 1618 Russell Street, Cheyenne, Wyo., is engineer.

Vt., Milton—Public Electric Light Co., St. Albans, Vt., plans addition to power plant at Milton, with installation of equipment for increased capacity. Cost reported over $75,000. Charles T. Main, Inc., 201 Devonshire Street, Boston, Mass., is consulting engineer.

Wis., Stiles—Oconto Electric Cooperative, Inc., Central Avenue, Oconto Falls, Wis., Earl G. Redman, general manager, has plans under way for new hydroelectric generating station on Oconto River, near Stiles. Cost about $200,000, including transmission line. Fund in that amount has been secured through Federal aid.

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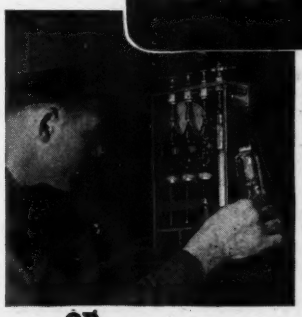

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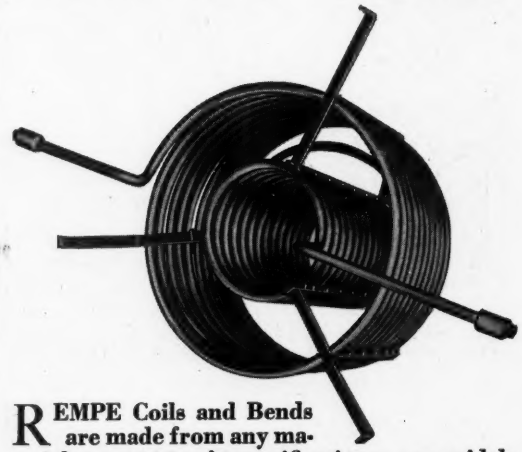

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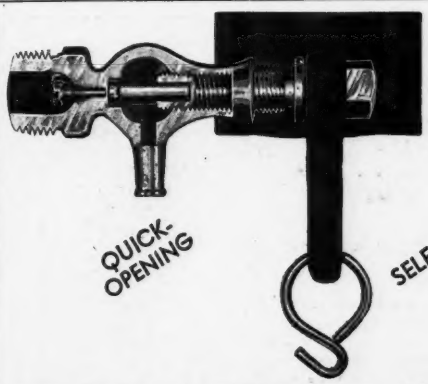

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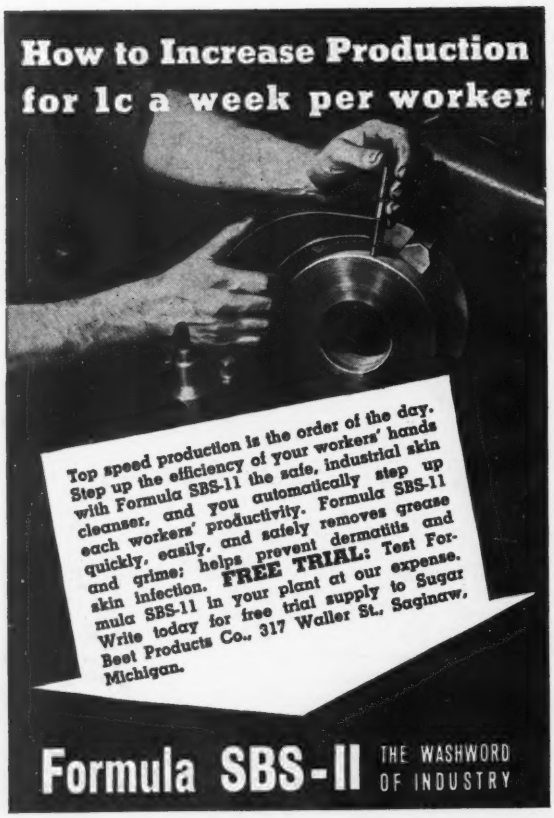
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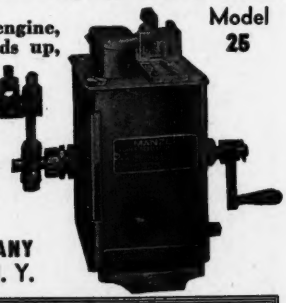

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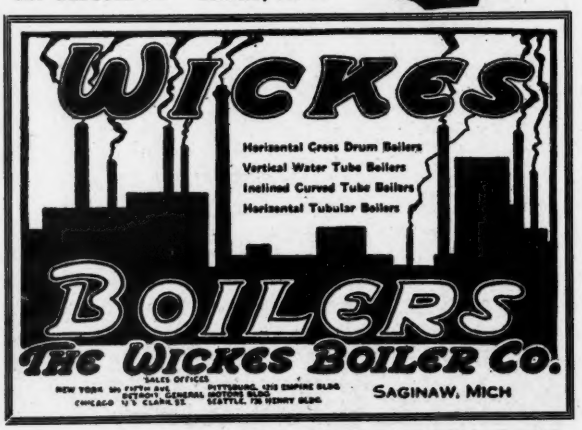

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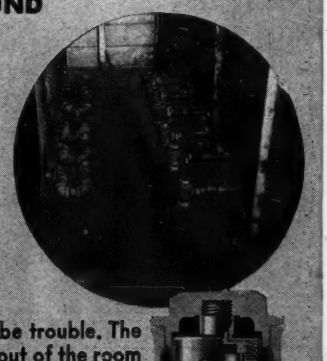

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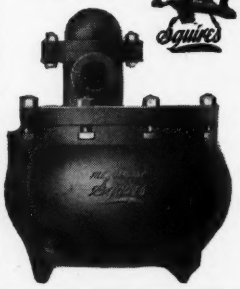

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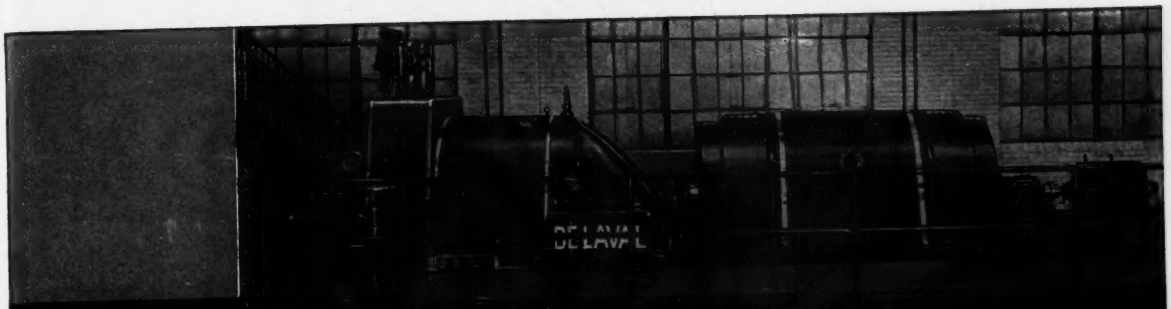
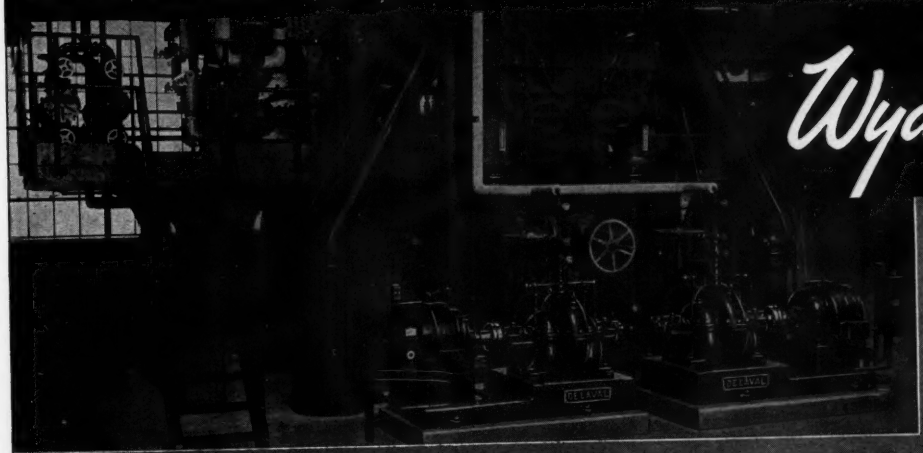


DE LAVAL TURBO-ALTERNATOR *at Wyandotte*



IN 1938, the City of Wyandotte, Mich., placed an order for a De Laval turbo-alternator to generate 4,000 kw. (5,000 kw. maximum) from steam at 425 psi. and 720° F., to be operated condensing, but with bleeder connections for feed heating and for heating the Wyandotte City Hospital. This unit, which has been in continuous service since January, 1940, operates in parallel with an older 2,000 kw. generator and with the power system of the Michigan Alkali Company.

The turbine is of the impulse type, with ample bucket clearances and with provisions to equalize expansion. An accurate and sensitive fly-weight governor controls the admission valves through two stages of hydraulic relay amplification and can be set manually or by the remote synchronizing device. The entire governor mechanism is housed in the turbine base, without exposed piping or mechanism.

Constructional details have been designed for high pressure, high temperature steam, with segregation of moisture in the low pressure stages.

The installation includes De Laval condenser circulating pumps, condensate pumps, boiler feed pumps and lubricating oil purifier. A similar De Laval unit rated at 6,000 kw. has since been ordered.

Further particulars are given in Leaflet T-3521, sent upon request

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES — STEAM, HYDRAULIC; PUMPS — CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED; MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS — WORM, HELICAL and FLEXIBLE COUPLINGS

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PLENTY OF PROOF... that..

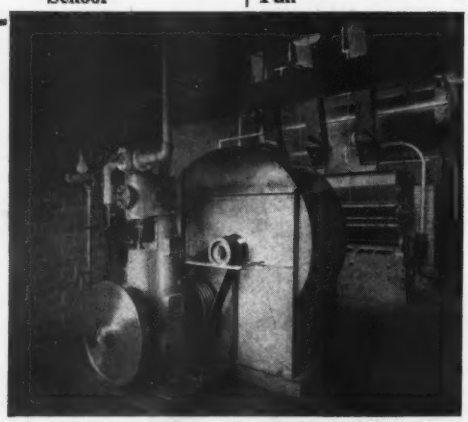
TROY-ENGBERG STEAM ENGINES

reduce power costs to a marked degree by making steam do double duty

THIS "double duty" objective is for those plants which use steam for processing or heating. The point is to first pass the steam through the steam engine or generating set and extract the inherent power without destroying its heating value. This is elementary, perhaps, but it results in worthwhile savings because the power costs so little.

Note, for example, what others in diversified industries are doing with modern Troy-Engberg Steam Engines in the way of reducing power costs:

Type of Plant	Driven Machine	Power Cost at Shaft of Driven Machine —¢ per Kw.-Hour Motor	Engine	Engine Power is—% Cheaper	Annual Return on Installed Engine Cost	Savings Will Pay for installed Engine Cost in—Months
Dairy	Ammonia Compressor	1.36	0.3	78%	144%	9
Soap Factory	Rolls	0.997	0.63	37%	19%	48
Utility	Gas Exhauster	2.15	0.69	68%	152%	8
Smelter	Forced Draft Fan	2.2	0.604	72%	74%	17
Waterworks	Centrifugal Pump	No motor data available	0.29	....	....	..
Oil Refinery	Rotary Pump	0.84	0.485	42%	50%	24
Hospital	Stokers	1.4	0.322	77%	74%	6
Chemical Plant	Blower	1.52	0.06	96%	360%	4
Paper Mill	Stokers	1.43	0.47	67%	50%	24
School	Fan	4.65	0.284	93%	284%	5



So why not make a note that when all this abnormal activity is over you will investigate the Troy-Engberg Steam Engine or Generating Set as a means of getting cheaper power?

TROY ENGINE & MACHINE CO.

Established 1870

839 Railroad Ave., Troy, Pa.

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